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DAIRY-COW DISEASES IN NEW ZEALAND.

RECENT RESEARCH WORK BY DEPARTMENT OF AGRICULTURE.

Paper read by C. S. M. HOPKIRK, B.V.Sc., Officer in Charge, Wallaceville Veterinary Laboratory, at the New Zealand Institute Science Congress, Auckland, January, 1929.

THREE diseases are to be discussed in this paper. Two of these have been well known all over the world for many years—namely, contagious abortion and mastitis (mammitis), while the third, a more recent arrival, has become noticeable in the last twelve years and is known as " temporary sterility " or " return to the bull."

Dr. J. A. Gilruth, and associated with him Dr. C. J. Reakes and Mr. H. A. Reid, have all done considerable work here on contagious abortion and on mastitis, but, although they have helped to throw more light on these diseases, they have not had better results with treatment than European workers. On account of the great economic losses associated with dairy-cow diseases in this country, a further effort by a team of workers has been for some time in progress in an attempt to find definite curative and preventive measures for combating the three major diseases. The team is composed of four veterinarians of the Department of Agriculture—Messrs. C. V. Dayus and W. M. Webster in the field, and C. S. M. Hopkirk and D. A. Gill in the laboratory—with the help of field officers of the Live-stock Division in general and of the Department's Chemical Laboratory for the analysis of pastures. It is proposed in this paper to deal with our work up to date in the field and in the laboratory, and to incorporate some of the theories leading up to the lines of work attempted. At this stage it must be pointed out that a knowledge of the causative organism of any one disease does not necessarily mean that the disease can be easily cured or protected against. The diseases will be dealt with in the order of mastitis, abortion, and temporary sterility.

MASTITIS.

Mastitis (inflammation of the udder) is known to the farmer as contagious mammitis, and was at one time differentiated from a non-contagious form. This differentiation no longer exists, and the

point requires stressing that all mastitis in the herd must be looked upon as contagious, even though it be not of streptococcic origin. Mastitis is a localized disease of one or more quarters of the udder, and it increased considerably after the introduction of the milking-machine. There is little doubt that the streptococci as a group are the organisms responsible for the enzootic forms of the disease in dairy cows. Acute cases of mastitis are found both culturally and microscopically to contain streptococci, often alone, but sometimes associated with other micrococci which may or may not increase the inflammation and resulting induration, but which are usually harmless saprophytes of the normal udder. At the present time we are not interested in other definite forms of mastitis, such as pure staphylococcic, or infection due to *Bacillus coli*, *Bacillus aerogenes*, or *Bacillus pyogenes bovis*. These are not uncommon forms, but do not compose ½ per cent. of the cases of mastitis examined at Wallaceville.

The streptococci have been placed in a group as causative of mastitis mainly because of the difficulty experienced in obtaining uniform reactions on media in the growth of organisms isolated from typical cases of the disease, and from the fact that occasionally strains have been isolated which differ decisively from the majority and resemble in some cases *Streptococcus lactis* and in others a morphologically different streptococcus of fæcal origin.

The organism mainly responsible gives the following reactions to media as a general rule :—

Morphology : Palisade growth in long, winding chains, in samples from acute cases. The length of the chains may alter considerably and in less acute cases they may be difficult to find, may be phagocyted, and, if found, are in chains of four to six individual spherical cocci. Cultural growth : The optimum temperature is that of body-heat, but no growth occurs at 10° centigrade in milk as in *Streptococcus lactis*. Sugar broth cultures (broth alone is not conducive to growth) of pH 7·2* gives a flocculent deposit, except in rare cases where turbidity is produced, in which case streptococci are present in very short chains. Sugars are not uniformly broken down, but there is usually acid and no gas production in glucose, lactose, saccharose, and salacin. No reaction occurs in inulin, nor usually in raffinose or mannite. Lactose litmus agar pH 7·2 gives an acid reaction to growth in twenty-four hours, and colonies may vary. Often one finds a smooth, entire, dome-shaped colony in twenty-four hours, which at forty-eight hours may give place to a flat, slightly ragged, rough, concentrically ringed colony, which resembles the rough type as opposed to the first smooth. Dissociation from smooth to rough is now a feature in streptococcal work and will be referred to later. Serum : Non-liquefying colonies similar to lactose litmus agar. Blood agar : Usually non-hæmolytic (no action on blood), yet on occasion green-tinged colonies have been noticed. Milk : Is coagulated in twenty-four hours usually, but sometimes takes forty-eight ; acidity about 0·62 to normal sodium hydroxide with indicator phenol-phthalein. Methylene blue : Inhibits growth in milk. Rats or mice are not affected by intra-peritoneal injections.

* pH refers to the hydrogen ion concentration of a substance, and is known as the "reaction." Above the neutral 7·0 a fluid is alkaline, below 7·0 acid.

The main lines of work which are being pursued with regard to mastitis are (1) diagnosis of the disease, (2) path of infection, (3) treatment and prevention.

(1) Diagnosis.

In order that the incidence of mastitis in herds may be correctly judged, so that the owner may eliminate the disease, reliable diagnostic methods must first be obtained. Manipulation of the udder is not reliable, as it fails to pick out many intermediate and other cases. A fine gauze strainer used for the fore milk is helpful in the more acute or in subacute cases.

The method of employing delicate indicator fluids soaked up and dried on blotting-paper has been attempted, the indicators being methyl red, neutral red, azolitmin, phenolphthalein, brom thymol blue, brom cresol purple, and Andrade's indicator. A slight reaction may be obtained with methyl red in acute cases, and a definite purple reaction with brom cresol purple, but the others are of little use. Brom cresol purple is at present being tried out on known herds, but is not likely to be entirely successful, because the chronic types of disease are not readily picked out by it.

Agglutination tests have been to some extent successful in the few attempted, and the records show the only sound cow in twelve to have been picked out; but the method is cumbersome, the antigen not stable, and antibody in the sera weak. The results, too, do not give one the picture which the microscopical test can. There is a recently perfected rapid agglutination method which is yet to be tried as opportunity offers.

The microscopical test is made after the milk-sample, which comprises the first strippings from the quarter, has been allowed to stand about one or two hours, the optimum being two hours. A loopful of the top layer, be it cream or other floating material, is then smeared over a glass slide, dried, and stained with Loeffler's methylene blue. Carbol thionine blue is unsatisfactory, and the gram stain shows only the organisms and not the leucocytes, besides taking up considerable time in preparation. An oil-immersion one-twelfth lens then shows the number of leucocytes in the secretion, and, if present in numbers, the causative organism. The examiner may then state the condition of the quarter—whether affected acutely, subacutely, or chronically. Because of the large number of milk-samples which one has to examine microscopically, no time can be devoted to an accurate count of the numbers of leucocytes to the cubic centimetre of milk. Therefore a practical method was required for comparison, and that was supplied by the symbols L_1, L_2, L_3. Later intermediate signs were added—$L_{\frac{1}{2}}$, L_1+, L_2+—giving, in all, six headings for comparison.

The correlation of results of many hundred milk-samples examined repeatedly shows that with experience the examiner is remarkably accurate in classifying the samples. The incidence of mastitis in herds in this country varies considerably, the numbers of cows affected being at present worked out in data from many experimental herds.

The microscopical test *cannot be doubted* after following histories of known cows for several years and of herds of cows for upwards of two years, except possibly where there is a fresh attack with *Bacillus*

abortus or where vaccinia is present on the udder-surface. Speaking of abortion infection, it may be dismissed at this stage by saying that little evidence can be produced, as certain workers in America claim, to show any connection between abortion and streptococcic mastitis, though *Bacillus abortus* may possibly set up acute inflammation of the quarter for some days, but with little or no induration. This statement is made after examination of herds throughout the country for both diseases.

Many cows during their milking career are at some time affected with streptococcic mastitis in an acute or chronic form, whether it be for a few days' or a few weeks' duration. This acute form subsides into a subacute and then into a chronic type, where the streptococcus is present in very small numbers but where some induration of the quarter may possibly be noticed. The streptococci themselves, however, do not wholly leave the udder tissue, but may persist for years. Cultural examination of milk in acute cases usually shows a pure streptococcic infection. From subacute cases streptococci and staphylococci—some 50 per cent. of each—are obtained. In chronic cases only a few streptococci are found, but an increase of staphylococci. These latter persist in great numbers in injured quarters, but during exacerbation of the acute inflammation—when streptococci, &c., appear in greater numbers for the time being—they disappear almost entirely. Examination of a number of normal cows of known history has been undertaken to show that no streptococci are ever found in the quarters in which leucocytes are not present and which are known to have been normal always ; but in the majority of such quarters the coccus present in chronic cases is found to be living quite harmlessly and saprophytically. Very few normal quarters are actually sterile. However, if a culture of this saprophytic coccus is injected into the udder, and the balance between the body cells and organism is thus upset, then a violent mastitis will result, the cow being obviously unwell, and running a temperature, and the quarter much swollen, hot, and painful, with an inclination to abscess-formation. This form of mastitis is apparently staphylococcic, and may exacerbate when the cow is dry, producing a large, swollen, fleshy gland before milk is produced in the udder, and is totally different from streptococcic mastitis.

(2) **Path of Infection.**

This is the biggest problem which we are up against in streptococcic mastitis. How, when, and why does the streptococcus reach and attack the udder tissue ?

So far the setting-up of mastitis by various means has been, except when the organism is directly introduced into the quarter, of a negative nature. No mastitis occurs with intravenous injection of culture ; drenching of the lactating cow with large quantities of affected milk does not produce the disease, but may set up scouring ; inoculation through the mucous membrane of the mouth and instillation of culture into the eye are ineffective. No results have been obtained by milking with hands washed in affected milk, or by leaving affected udder secretion on the ends of the teats over a period of a week on a number of cows. Injection of streptococci into the

uterus of a recently calved cow proved ineffective; yet one cow given acute strep. mastitis by injection of streptococci into a quarter later aborted a fœtus through streptococcic metritis, an unusual occurrence at Wallaceville, where no such case had previously occurred. This incident gives food for thought, but has not recurred.

The only method left to produce mastitis experimentally is to introduce the organism into the teat-sinus. Not only must the organism be introduced, but it is also required that the organism be of a definite type or that injury of the quarter also exists, to produce a lasting inflammation. On several occasions flocculating lactose broth cultures have produced an acute inflammation for a few days, but this has disappeared, leaving, as far as can be judged, no permanent impairment. If, however, we give udder secretion containing the streptococci as found in acute strep. mastitis, then acute mastitis follows, and the animal has typical acute streptococcic mastitis, known to the farmer as contagious mammitis. The disease does not require secretion from the acute stage of the disease only to be passed on to a cow, but milk from chronic cases which are macroscopically normal may set up inflammation. In one recent case, where a chronic milk was inoculated into a normal quarter of a clean cow, the result was a chronic type of inflammation, which took four days to show up macroscopically, but which on the third day showed a pure culture of streptococci. A second case was to some extent accidental, but this also took five days to show up, as follows: The effect of acid solution was being tried on a cow in quarters showing chronic mastitis and in those apparently normal. Normal saline solution of pH 6·5 was used, 100 cc. being introduced. The affected quarter was injected first, and then, after rinsing the teat-tube only in boiled water, a second normal quarter was injected. A third quarter, also normal, was then injected by means of a sterile teat-tube as a control. Mastitis showed up acutely on the fifth day in the second quarter, but subsided quickly to a subacute stage. In the affected quarter, however, acute mastitis became evident in a few hours, while the third normal quarter remained normal. There could have been very few streptococci placed in the second quarter, but they were able, nevertheless, to produce mastitis, and were helped, possibly, by the acid solution. Although streptococci were originally present in large numbers in the acute stage of the accidental case of mastitis, yet later staphylococci developed in large numbers, with only a few streptococci to be seen in culture amongst them.

The acid experiment was carried out because of recent work on dissociation of organisms into rough and smooth and intermediate types, and this dissociation has recently been shown to exist in the streptococcic group by an American worker. The rough type is a resistant organism, not nearly as pathogenic as the smooth type. The rough prefers more alkaline fluids, while the smooth prefers the acid range. Therefore on the introduction of acid to a chronic case it is possible that there was a change from rough to smooth in the quarter, with consequent acute inflammation. There is such an outpouring of alkaline fluid into an acutely infected quarter from the body that one would expect the smooth to give place after a while to the rough type, and thus acute mastitis would become chronic and the organism resistant.

If this theory is correct, it fully explains the method of attack of this organism and the reason for chronicity in the affected quarter. For some time it has been recognized that some other factor than the streptococcus itself existed. This factor was postulated as injury. We may in theory look upon injury, by whatever means it occurs in the udder—chill, knocks, milking-machines, hand-stripping, cow-pox, digestive disturbances, &c.—as causing an excess of lactic-acid production in the tissue of the part; and by this means smooth types are able to take hold and set up an acute inflammation of a part which at the time of invasion was debilitated by an acidosis and not actually inflamed. The exacerbation from the chronic type differs only in that the organism is present and requires the acidosis for setting up a more toxic condition. It is believed that milking-machines may become a serious source of injury when they are employed for too long a time on individual cows or at too high a pressure, and field reports confirm this. In our attempt to establish further this acidosis theory, a cow at Wallaceville has recently been fed on ammonium chloride in large doses to set up a general systematic acidosis. This cow was infected with mastitis four years ago during vaccine experiments, and has remained more or less chronic, with temporary exacerbation, ever since. At the time of the experiment two quarters were affected in a chronic form. Towards the end of three days' feeding one of the quarters showed a subacute mastitis which existed for a week after the finish of the feeding. The case did not become acute, but in becoming subacute showed possibilities, and the experiment will be repeated.

How infection takes place cannot be said at present. It may under exceptional circumstances be blood-borne in septicæmic conditions, but such cases must be rare. Infection apparently is usual through the teat-orifice. Experiments show that if only a very small number of organisms gain entrance it may take five days to show up. On the other hand, a massive infection or an infection with a more virulent type may show up in a few hours. Assuming the quarter is in a fit state of debilitation to become infected, what chance has the organism of gaining entrance through a tight sphincter-muscle opening, particularly in a hand-milked herd and with a non-motile streptococcus? With milking-machines there is very possibly a tendency, especially when the pressure is in the vicinity of 17 lb., for a slight back-suction into the teat to take place, and if this occurs one can understand why machines are so great a danger where mastitis exists in a herd. Experimentally this point is difficult to prove, though at the first opportunity a trial will be made. With high machine pressure it is known that quite a number of cases may result in a herd. Frequently the Department's officers will hear of some twenty cases occurring overnight when holidays, &c., have caused a careless use of the machines. Friction gives the injury; the streptococci present in the machine from chronic cases provide the organism.

On several occasions tests have been made to induce *Streptococcus lactis* to become pathogenic. Cultures in milk have been injected into the quarter, and when the resultant inflammation takes place a second quarter has been injected with material from the first. The second quarter shows slight inflammation, but the third quarter of the series does not respond, and the streptococcus is found in culture to have died

out. It is evident that the inflammation is set up in such cases from the acid formation of the *Streptococcus lactis* in the milk, and is not due to any toxin produced.

It is remarkable how quickly the udder tissue responds to any change of pH of fluids injected, or to any form of irritant fluid; but as far as can be seen no permanent injury results from such injections unless they break down the secretory cells, even though the saprophytic coccus may be present at the time of injection. This fact rather obliterates the suggestion that saprophytic staphylococci are causative of enzootic mastitis. While acute inflammation exists the coccus almost disappears, but reappears at the first sign of return to health or chronicity of the part. Heavy saline solution, acid solution in the vicinity of a pH of 4-5 (the end point of sugar metabolism by *Streptococcus mastitidis*), and irritant such as weak formalin or ether, all produce a passing inflammation which is not harmful, provided the streptococci are absent. The streptococcus itself will produce a certain amount of toxin, which accumulates in the milk secretion of the udder, but does not cause a clinical reaction in the cow. When the secretion from an acute case of mastitis is filtered through a Seitz filter and reinoculated into a clean quarter intense inflammation results, which again is only temporary. Such a filtrate does not kill an experimental animal such as the guinea-pig or rat, nor cause them inconvenience.

It may be mentioned in passing that *Streptococcus mastitidis* is harmless to human beings in the city milk-supply, and does not, as one frequently hears, cause sore throat epidemics.

(3) Treatment and Prevention.

Although the matter of path of infection is exercising our minds, there is also the question of treatment and prevention, which we are fully conscious of and alive to.

Curative treatment falls into two groups—the one chemical, either local or general; the other immunological, again local or general. In none have we been successful or even partially successful.

Many chemicals were tried by workers before the present team began work in New Zealand; those recently used were as follows:—

General—	
Per mouth	Potassium iodide.
	Formalin.
Intravenously	Acriflavine.
Local—	
Into udder sinuses	Brilliant green.
	Acriflavine.
	Ether.
	Formalin.
	Ether-formalin mixture.
	Selectan.
Intraparenchymatously	Selectan.

Immunological methods were tried in New Zealand in pre-war days by Mr. H. A. Reid, and consisted of the use of vaccine, and vaccine and sera combined. No beneficial results were obtained. Over the past three years individuals in several herds have been given treatments with vaccine made from autogenous strains of organisms, but

no curative results have been obtained, either with mixed staphylococci and streptococci or with streptococci alone.

A trial was also given Besredka's filtrate in several cases of acute mastitis. In this method the washing from the cells is said to contain a material inhibitive to streptococcal growth, and the filtrate is used in local injections or on pads in local infection in human work. Results, however, were entirely negative.

The prevention of mastitis is also difficult. The recent finding, mentioned earlier in this paper, that so many cows in dairy herds are affected, makes it practically impossible to dispose of those affected and retain clean animals as one would like to do. Until recently the cows at Wallaceville have never developed mastitis naturally, but within the last month two second-calf cows have shown infection in one and two quarters respectively. It may be that in this case a change of milkers has brought this about, and as some of the recent assistants have been inexperienced and heavy-handed men one might assume injury from that fact. The organism has been present for years in certain quarters of many of the cows, having been introduced experimentally into the animals, but no effort has been made to segregate those affected. At the time of writing this paper abortion was not known to be present in the young cattle, but since then cultural work has shown that one of these heifers with leucocytes in the quarters shows only staphylococci in culture and no streptococci. Also, she now reacts to the abortion test, and an effort is being made to find whether *Bacillus abortus* is the causative organism in the mastitis or whether the staphylococcus is the original culprit. It would be unwise to generalize on this case, and the results of further work are now being awaited.

Segregation of animals showing subacute or acute infection is possible and helpful. Such is being attempted on farms where the farmer is willing or can split his herd, and with the elimination of affected cows, which often, inadvertently perhaps, were placed on machines, there has been a marked diminution in fresh cases. Hygienic sheds and apparatus are matters of common-sense and need not be discussed here.

Vaccination.

The question of vaccination must be somewhat specially dealt with in view of the extensive use of this material by private concerns throughout the country. Previous experiments in which vaccinated cows were submitted to infection by the only means in our power—that of udder inoculation with culture or secretion—did not, in our opinion, show that the vaccine was of value as a prophylactic. Data have since been collected over a number of herds vaccinated with herd-autogenous streptococcus vaccines killed with formalin or with heat, and they show absolutely no change between the vaccinated and control groups in the herd. A method of tabulating samples from such herds has been built up as follows: The cases are shown by microscopical examination to contain leucocytes in amounts $L_{\frac{1}{2}}$, L_1, L_{1+}, L_2, L_{2+}, or L_3—that is, from chronic by grades to acute. Figures from 1 to 6 have been given these amounts, so that $L_{\frac{1}{2}}$ equals 1 and L_3 equals 6. Then by counting the vaccinated and control cows in each herd and making a percentage of infection against possible normality—for

example, three at L_3, five at L_{1+}, six at L_1, in twenty-eight cows gives (3×6) (5×3) $(6 \times 2) =$ forty-five in a possible of $(28 \times 6) = 168$. $\left(\frac{45}{168} \times 100\right) = 26$ per cent of infection.

By this means the following figures have been evolved from five of the herds under trial following four examinations of the samples—the first examination before vaccination, the others during or following vaccination.

Vaccinated animals, 155 head.	Controls, 64 head.
	Vaccinated. Per Cent. Mastitis.	Control. Per Cent. Mastitis.
First examination	15·5	15·6
Second examination	21·6*	18·8
Third examination	14·4	13·3
Fourth examination	18·7	17·5

* A slight rise after vaccination.

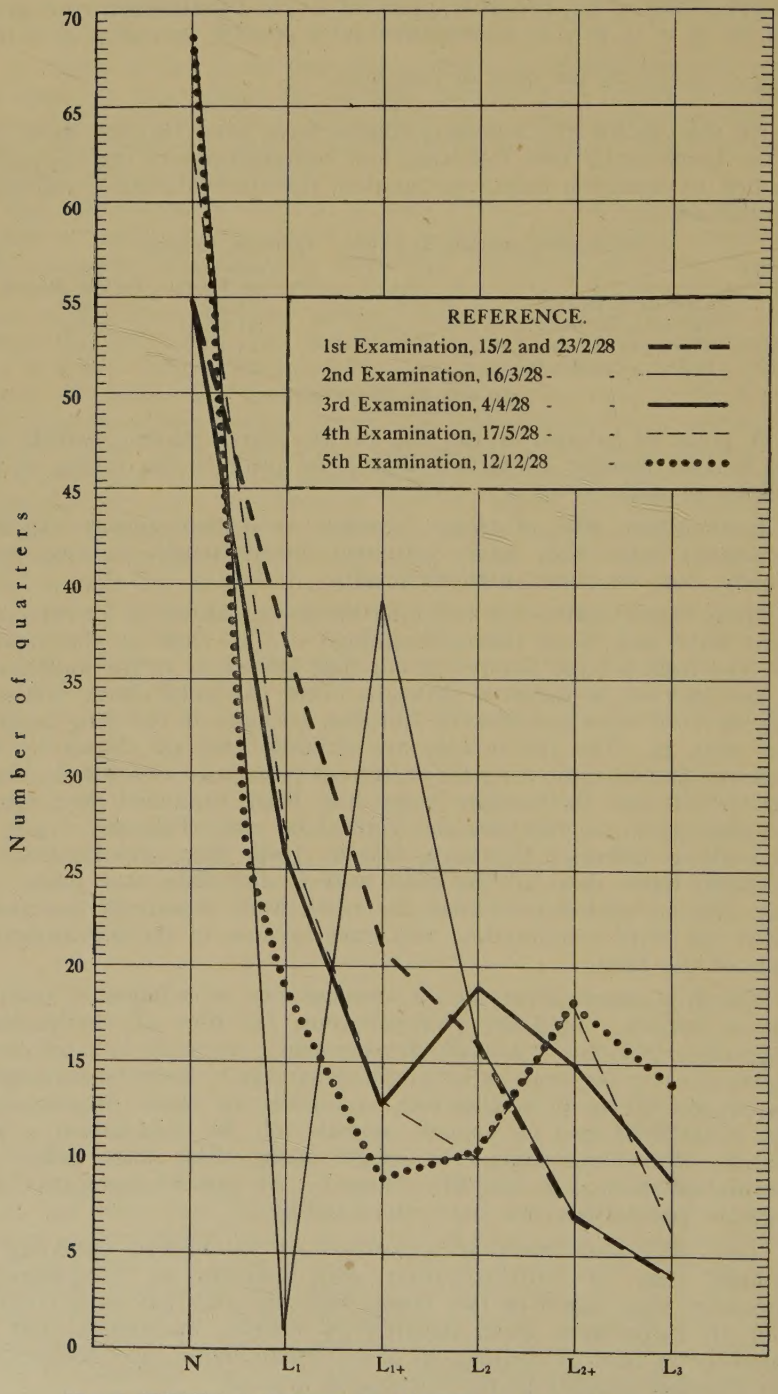
A point of interest is the rise in the fourth reading, which was due to bad weather conditions that arose prior to the taking of the samples of milk.

Examination will, of course, continue over two seasons. In two vaccinated herds they have continued intermittently for two years already, but, we claim, with no results.

Many opportunities for watching herds vaccinated by private concerns have not been taken advantage of, in view of the reports received from a large number of our field officers as to the inefficiency of the vaccine in different districts. One particular herd, however, was watched with considerable interest because of our long association with it. The percentages are striking, and are drawn by the same method of computing the results as previously mentioned. Each quarter of the thirty-eight cows has been examined five times, commencing at vaccination and carried on since February, 1928, at intervals as follows: February, Mareh, April, May, and December—at which latter date all the cows were in full milk once more. It may also be stated here that the cows were repeatedly inoculated about the third examination, and later because of the unsatisfactory state of the herd.

The five examination figures showing the percentages of mastitis are as follows: 15/2/28, 31·2 per cent. (at time of vaccination); 16/3/28, 30 per cent.; 4/4/28, 36·7 per cent.; 17/5/28, 31·1 per cent.; 12/12/28, 41·7 per cent. (See graph, next page.) From both groups of the above figures it is therefore impossible to claim improvement. The latter herd had no control animals left for comparison. Prevention, therefore, cannot be sought along those lines unless the vaccination method is radically changed. At present segregation and hygienic precautions are our only stand-by.

Trial was also made of a method of vaccination employed in anthrax—that of cutivaccination with cultures of streptococcus. Injections were made in two cows, with one cow left as a control; then all three were given mastitis by quarter inoculation, but no difference in time of cleaning-up of the inflammation was noticed, nor was mastitis avoided in the vaccinated animals.



GRAPH SHOWING INCIDENCE OF MASTITIS IN VACCINATED HERD.

CONTAGIOUS ABORTION.

Data collected in New Zealand on the disease known as contagious abortion have shown that the endometritis causing the actual abortion in the calf or retention of membranes as common symptoms originated from the action of the organism known as *Bacillus* or *Brucella abortus* (Bang). This organism is at present assuming greater significance in Denmark and the United States of America, because of the number of cases of intermittent fever in man ascribed to its presence in the blood stream. So far no cases have been known in human beings in New Zealand, but the Health Department is keeping in touch with modern findings and is watching for such cases. Curiously enough, all recorded cases have been in men and in non-pregnant women, so that the effect of the organism on the human genital tract is not known. There are cases of abortion due to other organisms, a few cases having been known due to a streptococcus, but these are in a decided minority. Also some are due to mineral deficiency, such as iron deficiency in the Mamaku area, and unrelated to bacterial invasion.

In one of our large dairying districts where careful observations have been made the disease is present to the extent of 4·1 per cent. in herd cows, but 11 per cent. in first calvers. There is evidence to show that first calvers at two years of age are more subject to abortion than first calvers at three years of age. Also that in good limestone country there is less of this disease than on lime-deficient farms. Whether, as in mastitis, this has a bearing on the reaction of the tissue to the organism resulting in different types has still to be worked out, but the suggestion was made in England recently that such was a possibility. The predilection of the organism is for the pregnant uterus and lactating udder, but no information has been found dealing with the pH of these organs compared with the rest of the body tissues. One would expect, however, that there would be in the pregnant uterus a decided acid reaction due to fœtal metabolism, more particularly at the cotyledons, where the disease organism attacks most heavily. Abortion occurs more often in the later months of pregnancy, too, which may have a bearing on the theory that the reason for the persistence of the organism in the uterus at pregnancy is because of the optimum conditions of that organ in acid requirements for *Bacillus abortus*. (Since writing that I have come across an article by an American group of workers showing that a decided increase in CO_2 is present in those two organs.)

One of the problems exercising us at present is the mode of entry of *Bacillus abortus*. It has long been recognized that contaminated pastures are a source of danger, the organism being able to attack animals after injection. Is there, however, a possibility of the bacilli gaining entrance by other ways? Recent experiments at Wallaceville show that the organism injected into the udder will set up acute mastitis, which lasts several days only but sets up an agglutination reaction in the cow. Such a reaction lasts at least three months, but it has not been decided whether actual abortion occurs as a result of this invasion of the udder. The cow affected is five months in calf. Will she abort? Two days ago the seal of the os cervix was obviously degenerating, and we confidently expect abortion within the fortnight.

Another means by which infection may possibly be set up is by the bull. This at present is very much doubted by workers on the subject. At the present time one of our Laboratory bulls has been given an intravenous injection and shows a decided reaction. This bull is now being used with seven known clean heifers to find whether the disease may be transmitted by copulation. Two heifers out of the three served in December have already given a marked positive reaction to both the intradermal and agglutination tests.

Diagnostic Methods in Control.

Diagnostic methods play a very great part in control of abortion. Such methods must be accurate, because many dairy-farmers employ repeated tests to eradicate the disease and keep their herds clean. The test used at Wallaceville is that known as the macroscopical agglutination test, applied to blood serum taken from individual cows. Such a test shows a large percentage of reaction in nearly every herd tested, but not all such cases abort. Data are being collected to show just what percentage of abortion can be expected in cows reacting. Another point of interest in data collected from reacting herds is the fact that about 1 per cent. of heifers pick up or retain infection and react to the test before pregnancy occurs. This percentage, however, is small, and differs remarkably in herds.

The macroscopical test takes twenty-four hours to carry out in its entirety, and therefore attempts have been made to utilize a rapid slide agglutination test which takes two to five minutes. Considerable experience is required, but over a large number of bloods we have shown that the test is slightly more delicate than the longer method; it does not, however, in our experimental work give the highest results which we require. Before Christmas last a test called the double intradermal test—employed in testing cattle for tuberculosis—was applied for abortion, and, from the results obtained in the herd, the test is sufficiently satisfactory to try under field conditions, in fact, the suggestion is that it is even more delicate than the agglutination tests. The drawback in field-work is the necessity for repeated visits of the veterinarian and the keeping of accurate skin-measurements during the test.

Recently a field test known as Bevan's abortoscope has been tried, but in our New Zealand climate the temperature is not high enough to allow the use of this test without an incubator. However, a modification of the test may be useful. Modification gave results in half an hour, but the reading did not appear as easy as with other methods.

It has been claimed in America that mastitis and abortion are correlated, but our New Zealand statistics do not prove this point, and we claim our results to be definite and correct so far as the agglutination test of blood-samples and microscopical examination of milk-samples can correlate the two diseases. Yet from one isolated case, in a heifer at Wallaceville (previously mentioned), we feel that there may be a relationship in occasional cases, and on that account we cannot be completely dogmatic.

Preventive Treatment.

Curative treatment for animals considered about to abort has not been attempted. The position of the organism as it exists in the

lesion in the udder and uterus makes the action of any drug on the organism impossible. Therefore reliance has to be placed on preventive measures. For over two years the Wallaceville Laboratory farm has been divided into two parts—one side running affected stock, the other running clean heifers born on the place from affected animals, but segregated and tested frequently to ensure their remaining clean. They have now calved twice, and neither abortion nor agglutination reaction has occurred among them. It is on these heifers that the infected bull is being given service. This method of dividing a farm is, then, a possibility where the farm lends itself to cutting up. One shed only is required, but two holding-yards, and the only precautions to take are to milk clean animals first, to see that the two herds do not mix, and to use separate bulls.

My latest returns, showing that three of these heifers have very recently indicated abortion, do not conflict with the statement that herds can be kept clean by segregation of infected animals. They do show that the bull is carrying abortion to the heifers. Two of the heifers had been served early in December and a third not until after the reaction had shown up. An explanation is required in the third case. Owing to error the services had not in all cases been performed on neutral ground, and in three instances the bull had run overnight with the heifers. It is a possibility that the heifer which showed a reaction may have been served with one of the others unnoticed, and this possibility is quite a sane one in that the heifer was noticed on one occasion to have a discharge on the tail, suggesting œstrum somewhere about six weeks after calving; and because she calved at the 276th day she would probably return to the bull, making the known service on 12th January her second acceptance. Even though unserved, there is every chance of her having picked up infection from the pasture from the bull's seminal discharge, if he is capable of transmitting the organism to the heifers.

Many countries have used one or another sort of vaccination for the purpose of preventing the disease. In England an extensive trial was given for some years to a vaccine made of live germs injected into the cows. The estimated lessening of abortion was only about 5 per cent. at the most, while the number of carriers made by this method was greatly increased. Dead vaccines were considered useless; nevertheless a vaccine made by killing the organism with chloroform was tried in Rhodesia, and claims were made that abortion was much reduced in native cattle. This method, being harmless, was given a trial in New Zealand last year in heifers, and, because of possibilities of errors in methods of inoculation, repeated this season. Figures and results are as follows for last year, and totals have been reduced considerably where herds were not kept as required by the experimental conditions imposed:—

Taranaki.

205 vaccinated heifers: slipped, 23 = 11·2 per cent.
442 controlled heifers: slipped, 38 = 8·6 per cent.

Wairarapa.

149 vaccinated heifers: slipped, 4 = 2·7 per cent.
29 controlled heifers: no slip.

A number of farmers are at present using lime in larger quantities, particularly in the water-troughs, but it is too early to ascertain whether the treatment is actually effective. A note is being made of the incidence of the disease where such methods are employed. As *Bacillus abortus* is an inhabitant of the udder during pregnancy, it remains for a cure to be found for both it and mastitis together.

We in New Zealand believe that there is considerable so-called herd immunity to abortion, and that after years of this disease in the herds the majority of older animals remain immune after their heifer days. This herd immunity probably arises from the udder infection, and is not a passive but an active immunity, and such immune cows are therefore dangerous to their pregnant daughters.

TEMPORARY STERILITY.

This problem, in which numbers of herds throughout the country contain a varying proportion of individuals which fail to conceive from the first two services, is causing far greater concern than other diseases which we know are infectious and contagious and which the causative organism is known. In temporary sterility there are many factors to be taken into consideration and many lines to work upon—so much so that we find our present team in no way adequate to carry out the necessary work as fully as we should like.

The condition, briefly put, is this: In the first year a large proportion of the cows of a herd return after the first service, which is usually allowed in October. Some cows, however, hold, which rules out total impotence of the bull. A large proportion of the affected cows continue returning regularly or irregularly, but will finally get in calf, often as late as in January or February. Many of these cows are slaughtered, and some are kept over the season and milked the following winter. At their first service in the following spring they hold. In an affected herd the second year finds many of the cows calving late—October, November, and December. The first œstrum following calving appears quickly, and the bull is allowed to mate. Such a service is usually unsuccessful, and we find a repetition of the first year's experience. In such cases quite a considerable proportion of these cows fail to hold for some months, but if held over will easily be got in calf. Therefore one is inclined to say that a genital rest is required. As the condition has been getting more prevalent for the last fifteen years and the average butterfat-production has also increased during those years, one is also inclined to hold that sterility is physiological and caused by greater development of the lactating function to the detriment of reproduction.

The question then arises, How could this occur? Is there an upset of balance among the endocrine glands, or has a mineral deficiency taken place due to the great quantities of lime and phosphate required to produce both milk and calf? As dairy herds in other countries are similarly affected, though largely fed on concentrates, we are rather inclined to think that diet is not the most general factor. However, work is being conducted on both the lines of research mentioned. (1) With minerals: Four farms have been top-dressed with lime and the necessary controls left for experimental purposes; in addition to

this, herds are being *fed* on minerals. (2) With endocrine extracts: Anterior pituitary lobe to increase the activity of the ovary; follicular fluid to increase the tone of the uterus for the attachment of the fertilized ovum; and in cases where œstrum is irregular but early the use of extract of corpus luteum.

In Denmark and in America it is the opinion of veterinarians that the condition is due to endometritis. Several reasons present themselves on the negative side, the first being the fact that on examination of many hundreds of cows at meat-works, following cull-cow drives in New Zealand, practically none of the animals showed endometritis or salpingitis. They did in many cases show cervicitis where the first fold is extruded through the cervical os, and many cows showed a cystic condition of the corpus luteum. Both these conditions might possibly be a result of endometritis, and possibly the original condition had disappeared, leaving the secondaries in its wake. But we have found all cystic corpora sterile, and have not found any one organism consistently present in the inflamed cervix. Another reason on the negative side is the fact that possibly 90 per cent. of affected cows return after first service, following what was considered by the farmer to be a perfectly normal calving. Analysis of calving figures, however, shows that in a large number of such cases the calving is a few days early. This fact is at present being demonstrated in heifers at Wallaceville. Three of the animals calved after 278, 276, and 274 days gestation. The other three calved at 283, 283, and 285 days. Two of the short-time group have returned more than once to the bull, while in the second group two have not returned. The remaining two have not yet had time to show up one way or the other.

This in itself suggests an endometritis present during gestation, but may also be physiological, due to an ovarian excess stimulation. That the endometritis if present is not due to *Bacillus abortus* has been amply proved over a series of several hundred cows. Should the condition be endometritis, to what organism is it due? Uterine and vaginal discharges have been examined from many cases, but no consistent growth of any one organism has been obtained. There is often a streptococcic infection of the cervix and vagina in cows, and a streptococcus of the alpha hæmolytic type has been isolated frequently, but numbers of varieties of this type appear. A cow was slaughtered at the Laboratory farm a week ago after returning to a third service, but bacteriologically nothing could be found which could be suspected. Histological results are not yet available, but macroscopically the uterus, tubes, and ovaries were normal. The cervix was slightly flushed and showed a minute flake of pus at the second fold, but as nothing but sporulating aerobes were found one cannot blame that portion of the genital organ. Ovulation had occurred normally, and a normal corpus luteum was being formed. The pH of the organs was also normal, giving a blue reaction to brom cresol purple papers.

Very serious consideration is being given to the position of the bull in sterility. Examination is now consistently made of the seminal fluid for its sperm content and for a possible flora. Clinical evidence frequently supports the theory that the bull is the chief infective agent, but if endometritis is present before calving we are examining the wrong bull or the right bull in the wrong season.

The secondary conditions confuse the issue in the investigation of this disease. Granular vaginitis and vesicular vaginitis, for the treatment of which a number of preparations are placed on the market, are in no way connected with the trouble. They may aggravate it when present, and should be treated where a catarrhal state exists. There are occasions, too, where impotence in the bull is the fault, but such cases are not general. Also, where heifers fail to conceive for their first calf one frequently finds not temporary but permanent sterility, due to cystic oviducts. Some suspicion attaches to the bull where a number of such heifers are found on one farm, but there remains the hereditary tendency to genital defect—a side which it is hoped to develop from the mass of data being collected wherever possible in the field.

Our principal experimental work lies then in—

(1) Collection of all data for sifting in the light of further knowledge.

(2) Bacteriological and histopathological work in bulls and cows, at calving and before service.

(3) Experimental infection of animals when suitable suspected organisms are isolated.

(4) A judicious use of post-mortem examination.

(5) Trial of drugs and endocrine extracts for specific effects on various organs.

(6) Experimental use of minerals.

(7) Chemical analysis of pastures. This work has only recently been commenced, and the few results to hand show an adequate supply of lime but a *low* phosphate content. Where the phosphate content drops to 0·20–0·24 per cent. P_2O_5 we find a total retention of the corpus luteum, due to inactivity of the ovary and to a total lack of œstrum. Such cows are affected with Waihi disease or aphosphorosis. Where the phosphorus reaches 0·6 per cent., however, the ovaries act normally, and cows may or may not be affected by the temporary sterility.

Where analysis will not help us is in connection with the vitamin content of pastures. The recently found vitamin E may have a distinct bearing on temporary sterility. The absence of vitamin E does not inhibit conception, but causes the death of the fœtus at varying intervals, which have not been worked out in larger animals than the rat. What we may have to consider, however, is not the lack of vitamin E, but the too great quantity of the material in the pasture. Vitamin E exists in the green luscious pastures, and it is in this state that the pasture is eaten by cows when the trouble is rife. As the grass dries and becomes shorter, then the cows conceive. That vitamin in excess as well as in too small quantity may have a bearing on disease is suggested by German workers, in particular where vitamins A and D have been used; so that although the possibilities of excess of E are not actually grave, yet every theoretical avenue must be explored practically.

At this stage no exact and specific treatment can be suggested for general use by the farmer, for the etiology is entirely unknown and a matter for conjecture only. Experimental treatment has been undertaken widely with very mixed results.

In early years much general washing out with a variety of stimulating, antiseptic, or astringent chemicals was tried regularly, but the irritation to which the cows were subjected sometimes became an act of cruelty. Later specific washing with drugs for special effects was tried, more particularly to reduce the inflammatory state of granules in a number of the cows where granular vaginitis occurred as a secondary characteristic, or to reduce the cervicitis found present very generally in such cases. One point noticed in connection with such washing was the intense straining caused by mild solutions, and this could only have been due to the action of the fluid on the inflamed anterior vagina. Another point of interest noted at this time in the handling of cows was the fact that on going through a herd it was possible by the state of turgidity of the lips of the vulva to say with considerable degree of accuracy which cows were in calf, provided they were three weeks in gestation and not more than some nine weeks. This point was verified by three field veterinarians.

Recently washing was superseded by swabbing of the inflamed cervix through a speculum with soothing chemical agents, and at times some degree of benefit appeared to be derived by this treatment. However, results were not sufficiently good to make the method general. A number of farmers and some veterinarians now attempt a simple method of treatment which has been in vogue for a considerable time and at times seems to be effective. That method is the pushing of a finger into the cervical os in order to clean out the plug of mucus which occasionally lodges at the entrance. This mucoid material is likely to form with any inflammation of the cervical canal. A similar method is in use in human medicine by instrumentation, and beneficial results have been often obtained even though nothing abnormal could be found in the cervix. Apparently stimulation alone may be useful.

The latest method is that practised by Professor Neilsen in Denmark, consisting in the passing of a catheter into the uterus for irrigation purposes, and this method is now under trial here. In the hands of a skilled veterinarian there is some risk of passing the catheter through the uterine wall, so that the method will not become a general one for use by farmers; but it is required in order to ascertain whether we are dealing with an endometritis, or at the least some inflammatory state of the cervical canal which will respond to such treatment. Late advice from the field is that, although a number of cows have been tried, results do not appear satisfactory; but in the hands of a second field veterinarian results in eight hundred cases are said to be hopeful.

Properties of Superphosphate in Plant Husbandry.—Discussing papers presented at the recent Washington International Soil Congress in the *Journal of Science*, Mr. T. Rigg remarks: "In a paper dealing with the growth of lucerne on acid soils it was shown that, in the particular cases examined, manuring with phosphate did not increase the percentage of phosphate in the lucerne-plants. In view of the well-known response of pastures, lucerne, and other crops in New Zealand to superphosphate, it is most important that careful study should be made of the exact part played by phosphorus, sulphur, and calcium, which are all contained in superphosphate, on both yield and quality of New Zealand crops. It does seem possible that in a number of cases greater benefit has been ascribed to the phosphate contained in superphosphate than actually occurs. Several workers both in California and in Tennessee pointed out the importance of small traces of such chemical elements as boron, manganese, and copper in plant-nutrition. . . . "

FARMING PROBLEMS IN CANTERBURY.

CURRENT RESEARCH WORK OF THE FIELDS DIVISION.

A. H. COCKAYNE, Director, Fields Division, Department of Agriculture.

APART from general instructions and advice on better farming methods, the Fields Division is carrying out a large volume of research and investigation work on farming problems in Canterbury. For practical purposes this work can be divided into four main divisions as follows :—

(1) The most profitable manuring for grain, fodder, and potato crops.

(2) The demarcation of soil and pasture types on which top-dressing is likely to be payable.

(3) The elimination of diseases and pests in grain and other crops.

(4) Improvement in crop-production by the utilization of superior types, and by means of crop certification.

Improvements in Manuring of Crops.

WHEAT.

Manurial work with wheat is now in its fifth year, and with increase in opportunity the operations this season have expanded considerably. There are twenty-seven series of experiments on farms in Canterbury and North Otago. In each various forms and quantities of phosphate are included. The main objective is to determine what phosphate and what amount is most profitable to use, leading, with an extension of the present programme, to the demarcation of the high and low phosphate-response soils as they exist over the wheat belt.

From the experiments conducted up to the present it has been shown that 1 cwt. of superphosphate on the average increases the wheat-yield from 4 to 5 bushels per acre, and is in general highly payable, but that there are areas where no significant increase can be recorded. The most important result from the work has been the demonstration that high phosphate-response is just as regular on the 60- to 70-bushel crop as it is on the 25- to 30-bushel yield ; also that high response is likely to occur equally whether the prior crop has been a harvested one, a fed-off green crop, or roots. Before work was commenced in Canterbury, wheat after rape was rarely manured, yet many of our most significant increases have been secured where the prior crop was of this type.

One of the main difficulties against a rapid extension of this important work is the problem of the harvesting of a very large number of plots. The cereal investigation projects that have been laid down this season necessitate the separate harvesting and weighing of over six thousand plots, and in order to secure efficiency adequate apparatus is necessary. In past years a small mill driven by a tractor has been used, but this season a special easily transported threshing unit has been devised that will enable all the plots to be harvested accurately and expeditiously.

Until quite recently it was not considered that nitrogen in increasing the yield of wheat was likely to be profitable, but the work under this project has shown that nitrogen top-dressing in the spring, in addition to phosphate application at the time of sowing, is likely to be a sound manurial practice. Last season over a number of trials nitrogen in the form of nitrate of soda at the rate of 1 cwt. per acre increased the wheat-yield by 6 to 7 bushels per acre over and above the 4- to 5-bushel increase secured through phosphate. This season some twenty-five carefully conducted experiments with nitrogen are being carried out, and in addition some three hundred demonstration areas have been top-dressed. Experiments also as to the relative effects of various types of nitrogen have been laid down.

If this season's results again demonstrate that nitrogen top-dressing is likely to be highly payable, experiments on amounts, kinds, and time of application will have to be undertaken. The fact that in a great number of instances phosphate-manured wheat has in the spring the typically pale coloration indicating nitrogen starvation is being taken by the Division as a pretty clear indication that top-dressing such crops with nitrogen would be a payable practice. An element of uncertainty lies in the fact that extensive nitrogen work with wheat has been largely confined to the past two seasons, both of which may have been particularly favourable to nitrogen response. However, the fact that for three seasons in succession payable increases have been recorded on one particular farm would seem to indicate that seasonal factors were not the definite cause of high response.

TURNIPS.

In the drier parts of New Zealand super has been shown to be the best phosphate for turnips up to 1 cwt. per acre. Above this amount its solubility is apparently disadvantageous, and its depressing effect on germination serious. The standard Canterbury dressing of 1 cwt. per acre has been shown to reduce germination by some 20 per cent., and 2 cwt. per acre reduces it by over 50 per cent. This refers particularly to Canterbury, where one-third of our turnip crop is grown, but germination injury is common throughout. Bad effects on growth always follow germination injury. The methods under trial to overcome injury are (1) pre-drilling portion of the manure, (2) post-drilling portion of the manure, (3) reversion of the super by mixing it with lime.

The use of lime with super has increased the germination in certain cases by 50 per cent., and the yield by 20 per cent. in some instances. Much requires to be learnt regarding the amounts of lime to use and when it should be mixed. Mr. W. D. Reid, in connection with his legume nodule organism work, is working out a clever method of testing the injurious effects of manure, using the nodule organism as the indicator.* This will enable a drastic reduction to be made in the number of treatments necessary to test in the field.

Methods whereby heavier applications of phosphate may be safely used will be of the very greatest value throughout the whole of

* See article by Mr. Reid describing an experiment with lucerne-seed, page 103 of this issue.—ED.

Canterbury, and this work can perhaps be viewed as being one more pregnant with immediate possibility than almost any other undertaken.

RAPE.

Four years' work in Canterbury with phosphate has definitely shown that the slow-acting phosphates by themselves are definitely inferior, but when used in combination with super the results are far superior to where super alone is used. Nitrogen has increased the crop by 25 per cent., being payable on good crops, but not so on poor ones. A large number of trials are being conducted this season.

POTATOES, ETC.

The work carried out indicates that increases of from 1 to 2½ tons of table potatoes are secured with 3 cwt. of super; in fact, the manuring of the potato crop is the operation which shows the greatest profit, and at the present time it is the one that is most neglected in this respect.

So far as other annually sown harvested crops are concerned, such as barley, oats, peas, linseed, &c., no properly planned work has so far been attempted.

INCIDENCE OF MANURING.

In order to secure fairly reliable information regarding the amount and incidence of cereal and other crop manuring (information of great value in planning experimental location) it was arranged with the Government Statistician for such information to be included in the "acreage sown" cards that he sends out each spring. The results of this collection are of distinct interest. Of the 200,000 acres of wheat in Canterbury this season some 130,000 acres have been manured. Out of 130,000 acres of oats, 75,000 acres have been manured, and out of 11,000 acres of potatoes less than half—namely, 5,000 acres—have had manure applied. These figures indicate that the Canterbury farmer is by no means taking full advantage of the profit resulting from rational manuring, and show the necessity for extended demonstration. It is safe, however, to say that the comparatively large areas of cereal crops which have been manured are a direct reflection of the extended experimental work that the Division has carried out.

Demarcation of Soils and Pasture Types on which Top-dressing Response is likely to be payable.

Some two hundred distinct top-dressing trials to be carried out over a series of years were laid down during last season, and these should give extremely valuable information. Owing to the small response from top-dreassing on much Canterbury land, renewal of pastures to keep up an adequate supply of young and vigorously growing grass will have to remain on such land an integral feature of management. But it is essential to find out on what soils and under what conditions top-dressing will enable grassland to remain essentially young in character longer than at present. In many cases at present pastures are old and useless for rapid milk- or meat-production at the end of the third year or earlier. Where top-dressing is payable the tendency must be to extend the profitable life of pastures, but where it is not so an increase of cropping leading to more rapid renewal of grassland

would appear sound. At the present time less than 1 per cent. of the sown grassland of Canterbury is top-dressed. This is in striking contrast to the 85 per cent. that is annually top-dressed in Matamata County, in the North Island. Phosphate responses in parts of Canterbury are highly satisfactory, but in others they are not payable, and the work now being undertaken should enable the Division to say with far more assurance than at present when and where top-dressing should become a regular practice.

Elimination of Diseases and Pests in Grain and other Crops.

Perhaps the most significant achievement of the Fields Division in the past five years has been the brilliant work of Dr. G. H. Cunningham in demonstrating that a large number of our most serious crop-diseases are seed-borne, indicating the importance of using seed that is free from disease. A very great deal of work has been and is being conducted along the line of seed-treatment, and with regard to the barley crop several serious diseases have been more or less eliminated from considerable areas of New Zealand. The control of seed-borne diseases represents the major line of attack that is being made by the mycological specialists of the Division, and this is very closely connected with certain phases of crop certification, the final objective being an adequate supply of disease-free seed to be made available for all farmers.

Another line of research that is being actively prosecuted at the present time is the control of certain insect pests, notably turnip-aphis and diamond-back moth, both of which seriously limit the optimum production of the turnip and rape crops in Canterbury. Here biological control by the use of natural enemies appears to be the most hopeful line of action, and a thorough study of all known natural enemies is being made by the entomological staff of the Division.

Superior Types and Crop Certification.

The Agronomist in charge of this work is using the method of crop certification as the basis on which the whole of the work finally hinges. The final objective of certification is to enable farmers to secure reliable seed true to type and disease-free. It is not to be expected that strains absolutely true to type and free from disease can be made available immediately; but this is no reason why crop certification should not be put immediately into operation, enabling the hall-marking of the reasonably pure and reasonably disease-free crops as against what may be termed the "scrub" crops of the country. Ability on the part of the farmer to secure "certified" seed representative of the best crops in the country, rather than perhaps the worst, will be of enormous advantage. The very considerable success already following the initial work in potato and wheat certification has shown conclusively that crop certification is as important in crop-production as herd-testing is in milk-production.

Certification of crops as they exist can be put into operation just as fast as it is known what characteristics should be certified to, and whether the certification of certain characteristics is a reliable guide

to the superior qualities of any crop. In the securing of such knowledge an immense amount of work is involved—in strain selection, experimental and field testing, ascertaining of disease resistance, disease treatment, and a host of other considerations. At the beginning certain assumptions have had to be made, and these and any further assumptions have to be proved or disproved by accurate trial and investigation. The case of the potato may be taken. It has been assumed that with regard to any particular variety the best crops are those that contain few rogue plants and are freest from disease. Certification so far has been based on this assumption, but there is also the assumption that certain strains within any variety are better than others, and that the presence of certain diseases is far more objectionable than the presence of others. These assumptions have all to be studied, and by the final production of the best types of pure line strains, free from any diseases of moment, it is hoped to achieve great improvement in the crops. Certification is to be used to segregate the better from the poorer crops at present grown, and later on it will also be able to retain the identity of any new strains, or any crops that are free from diseases that are carried in the seed.

Again, there are certain assumptions—particularly true with regard to grasses and clovers—that crops in certain districts and under certain conditions of management produce better types of seed than others. The actual isolation of special types and their thorough testing is a matter that may take many years; but there are some points with regard to certain grasses and clovers which could rapidly be put under certification. The value of such certification could be tested, and if found reasonably sound could continue until such time as definite specially selected and tested strains were available for certification. The following are examples of such types of temporary certification; some are to be put on trial this season: (1) Cocksfoot certified to be from pastures over ten years old; (2) white clover certified to be from pastures over twenty years old; (3) brown-top certified to be free from red-top; (4) red clover certified to be from crops that have been harvested for seed three or more years in succession; (5) red clover certified to be free from dodder; (6) Hawke's Bay rye-grass certified to have been produced in Hawke's Bay or Gisborne.

It is perhaps not generally realized how greatly the agricultural instruction and research work of the Fields Division has increased in Canterbury during the past six years. There is now a staff of eight under the control of Mr. R. McGillivray, Fields Superintendent. In addition, the Agronomist, Mr. J. W. Hadfield, and his staff are located in Canterbury, while much of the work of Mr. A. W. Hudson, Crop Experimentalist, Dr. G. H. Cunningham, Mycologist, Mr. J. C. Neill, Field Mycologist, and other officers of the Plant Research Station of the Division is concerned with research and investigation into problems that are particularly concerned with the future progress of Canterbury agriculture.

Finally, much useful co-operation is being maintained with other bodies or institutions concerned with the agriculture of the province, such as the Canterbury Agricultural College.

HIGH PROTEIN CONTENT OF PASTURE.

RESEARCH ON SUGGESTED RELATION TO DAIRY COW DISEASES.

B. C. Aston, F.N.Z.Inst., Chief Chemist, Department of Agriculture.

Attention having been drawn to the possibility that a ration having a high protein content, such as that furnished by the richest New Zealand pastures, may have a considerable influence in contributing towards the incidence of reproductive troubles in cattle, the matter is now being investigated by the Department of Agriculture. Farmers are asked to assist those officers who are collecting samples for this purpose. The evidence so far gathered shows that this is a line of investigation well worthy of thorough inquiry.

North Island soils are usually well provided with the valuable fertilizing-agent nitrogen, and this is reflected in the better pastures, where extraordinarily high figures for nitrogen, and consequently protein content, have been lately recorded in the lower Wairarapa, Waikato, and Nelson districts, the last by Mr. T. Rigg, of the Cawthron Institute. This would not warrant special mention of the matter if at the same time there were not appearing in New Zealand troubles in stock which may possibly be referred to an excess of nitrogenous constituents in the diet. Many years ago at Waitotara nitrates or nitrites in mangels were held responsible for the deaths of many cattle and pigs when fed on these roots growing in the field (this *Journal*, Vol. 3, page 311, 1911). This will show the high percentage of nitrates which may occur in New Zealand soils under favourable conditions. The pulpy kidney condition in lambs occurring in Central Otago and other districts has been associated with an excessive proportion of amines in the spring grass, and this has been suggested as a cause of the mortality (*Journal*, Vol. 34, page 231, 1927).

Bulletin 417 of the Ohio Agricultural Experiment Station comments on the fact that three experimental cows dieted on the "narrow" ration of 1–2 suffered from temporary sterility, became very thin, and seemed to tire of the ration. The authors say, "Their response to this ration is especially interesting in the light of many complaints which have come to our attention regarding breeding difficulties that seem to attend the use of high protein rations." The ratio 1–2 of digestible protein to non-protein is what is called a very narrow one—that is, the protein is excessively high compared with the non-protein; but it is important to note that some New Zealand pastures provide even a narrower ration than this.

The suggested remedy for this state of things is to widen the ration by giving a feed of much lower protein content, supplementary to the pasture. What is at present required is more information, for the problem of temporary sterility is dairy herds in one of immense importance. If herds which receive summer supplementary feed such as green oats, green maize, turnips, sugar-beet pulp, and maize or other starchy meals low in protein do not suffer, it warrants further inquiry. Woodman (*Journal of Ag. Science*, Vol. 6, page 25, 1926, and *Scot.*

Journal Ag., Vol. 11, page 383, 1928) appears to have suggested something similar, and if this is so where the protein content of pastures is not so high as in New Zealand, how much more necessary is it here. He says, "It appears justifiable to assert that optimum results are not possible on closely grazed pasturage with any class of stock—young grazing stock, dairy cattle, and fattening animals alike—unless such animals are receiving, at all stages of the season, some supplementary food which is richer in carbohydrates." He also suggests that carbodydrate supplements might materially mitigate evils, such as scouring in early spring, possibly due to excessive digestible protein.

DAIRY-FARMING ON SECOND-CLASS BUSH-LANDS.

NORTH AUCKLAND SETTLERS' EFFECTIVE WORK IN PASTURE-MAINTENANCE.

C. J. Hamblyn, B.Ag., Instructor in Agriculture, Whangarei.

Throughout North Auckland large areas of second- and even third-class bush-lands are used for dairying. The comparatively small holdings of from 100 to 500 acres, together with the generally limited financial resources of the farmers on this type of country, are the two chief reasons for the development of dairying and lamb-raising in preference to dry-stock farming, though in many cases the two are successfully combined. With the rapid falling-off of surface fertility after the first period of profitable grass-production, lasting from four to six years from the initial burn, the opening-up of the sward is followed on the one hand by a replacement of the better grasses by brown-top, danthonia, or paspalum, and on the other by secondary growth of various sorts such as bracken-fern, manuka scrub, &c., the type of reversion depending largely on the original sowing of the burn and the subsequent management. Where the dairy cow is the revenue-producer on the farm the reversion to inferior pastures or to secondary growth means a very definite reduction in carrying-capacity and falling-off of returns, and generally—since sufficient dry stock cannot be maintained—fern and scrub tend to take charge before the slower-establishing grasses can take up the running.

With the extension of the North Auckland railways, together with lower freights, better roads, and cheaper fertilizers, manurial top-dressing is beginning to play an ever-increasing part in the maintenance and improvement of the pastures on these farms. But the outstanding instances of improvement in all these districts are those where the manual labour on the farm has been brought to bear in preparing the way for successful and profitable use of top-dressing and regrassing.

Logging up of the felled bush areas, and cutting of the fern and other growth by hand or machine where possible, followed by burning

off, disking, and harrowing of the easier slopes, and resowing the burnt patches, combined with top-dressing, are the methods used, the only cash expenditure being for the grass-seed and manure. The longer this process is delayed after the first falling-off of pasture-production, the slower and more costly is the renovation; but, realizing that for profitable dairying good pastures are essential, farmers are putting their backs into the work, and so long as the grass is given a chance by the removal of the second-growth shade and the very favourable opportunity for invasion occurring among the rotting stumps and logs, top-dressing, combined with efficient management of pastures with the dairy herd and the young stock available, is proving both profitable and successful in keeping out the objectionable secondary growth.

Viewed as a whole, the second-class bush-lands of North Auckland, where dairying is perforce the main source of revenue, represent a wide range of soil-types, and an even wider range in the stages of reversion reached. Generally it is being more and more clearly recognized that, since the dairy cow unassisted is practically useless in the control of secondary growth and requires good pastures to be profitable, the old methods of cleaning up haphazardly with the fire-stick lead to a dead-end. The practice of thoroughly cleaning up a paddock at a time by manual labour in order to concentrate and control the fire, surface cultivating wherever possible and necessary, reseeding the patches, and top-dressing, followed by subdivision and the better control of stocking, though slow, is giving excellent results. This means not only increased carrying-capacity and returns, but also a marked increase in the farmer's assets represented by good steadily improving pastures, as against the equally steady and inexorable deterioration that goes on where no concentration of effort is made.

As an outstanding example of the results of concentrated effort on the part of a settler in combating the natural tendency of his section to revert to secondary growth, as evidenced by the experience of neighbouring farmers, the following history of a bush section is given. Five hundred acres of second-class bush-land (sandstone country) were taken up in 1920 by two returned soldiers, Messrs. McCullough Bros., at Takahue, near Kaitaia. Forty acres had been felled and sown, and fern and manuka were coming in. By 1923 a total of 180 acres had been felled and sown. No more bush was then cut. During the 1925–26 season thirty-two cows were milked, and extra unprofitable dry stock had to be maintained in an effort to keep down the secondary growth, which was rapidly coming in and just as rapidly reducing the carrying-capacity in dairy cows. In order to increase the carrying-capacity there was a choice of felling more bush (the usual practice) or improving what was already in grass. Realizing that about one-third of the area was unproductive owing to logs and stumps, and that according to the experience of neighbours they were not likely to maintain a material increase in the carrying-capacity in cows by felling more bush, they decided to tackle the problem by logging up and top-dressing.

The standing bush was not likely to deteriorate, and with the advent of a metalled road and a demand for easily accessible timber

it was felt that in the millable rimu, &c., there might yet be a valuable asset which would otherwise be destroyed. Commencing in 1926 and working between milkings, some 30 acres were logged up, the scrub and fern cut and heaped, the patches burnt and sown, and the area top-dressed with basic slag at 4 cwt. per acre. The total cash outlay amounted to £57 for seed and manure landed on the farm. For the season 1926–27 forty cows were milked, giving an increased return of 1,804 lb. of butterfat, or a cash increase, at 1s. 4d. per pound, of £120.

FIG. 1. REVERSION OF BUSH-BURN GRASSLAND TO SECOND GROWTH.

In 1927 another 30 acres were dealt with in the same way, and the first area top-dressed again at the rate of just under 3 cwt. per acre of basic slag. The herd was increased to forty-six, but, owing to the extremely dry season, though the returns to the end of January were over 800 lb. butterfat ahead of the previous season, the final returns were only 36 lb. ahead. This represented an increase of 1,840 lb. butterfat above the 1925–26 season for an extra outlay of £75 in seed and manure.

During 1928 a further 65 acres were cleaned up by the same methods, and top-dressed with 13 tons of basic slag, while an additional area of 15 acres not logged up received 3½ tons of top-dressing. The total expenditure in grass-seed and manure this year was £131 10s., the herd was increased to fifty-five cows, and the returns at the time of writing (20/11/28) were 1,114 lb. of butterfat ahead of the previous season.

The net results of Messrs. McCullough's efforts so far are that of the 500 acres in the section 280 acres are still in bush and definitely increasing in value on account of the millable timber, 125 acres have been cleaned up and top-dressed in the three years and are now carrying fifty-five milking-cows and double the young stock during

practically the whole of the milking season, an additional 15 acres have been top-dressed, and the way is clear for the rapid improvement of the remaining 95 acres, with a consequent increase in the herd, which they hope to build up to between eighty and ninety cows within the next few years. With the start of 6 tons of manure and their labour

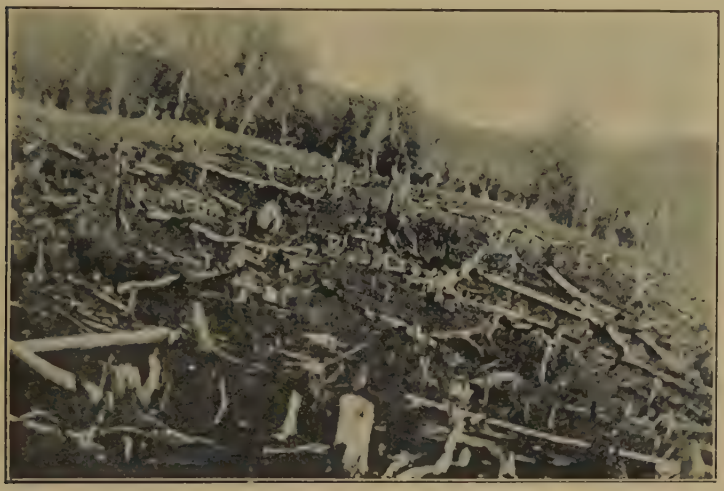


FIG. 2. AN UNLOGGED HILLSIDE, FIVE YEARS AFTER FELLING OF BUSH.

FIG 3. ANOTHER SPUR, LOGGED AND TOP-DRESSED WITH BASIC SLAG, FIVE YEARS AFTER FELLING.

[Photos by McCullough Bros.

they have been able easily to pay their way, both as regards the purchase of the extra cows required and the grass-seed and manures used.

A very important feature of the subsequent management of the pastures is the development of annual top-dressing and further subdivision, together with, wherever possible, tripod harrowing of the paddocks, and above all an efficient system of grazing in order to keep in check the tendency for fern to come in. In this connection Messrs. McCullough favour paddocks of about 15 acres. The cows follow a definite rotation of from two to three days and nights in each paddock; the young stock are used immediately behind the milking cows to clean up, and each paddock is spelled for at least two weeks before the next grazing-period. In this way the cows get the best of the grazing, the dry stock do the cleaning-up, the pasture is periodically spelled, and a close sward is maintained. No doubt with the development (as soon as the work of cleaning up is completed) of annual top-dressing and regular tripod harrowing it will be found that the size of the paddocks can be reduced, and the management problem so far as fern invasion is concerned materially lessened.

It is often argued that the cost of logging up and clearing bush-burns in the early stages is prohibitive. In this case it has been done as part of the work of the farm—an application and utilization of the available manual labour in a particular direction, with no cash outlay but with very desirable results. In the 125 acres dealt with the original burns were from three to seven years old, and portions of the original burn when the farm was taken up were also cleared. The total time occupied in logging up and burning amounted to 310 days of eight hours each, and the time spent in cutting and burning fern and scrub totalled seventy-six days of eight hours each, making a total cost for the 125 acres, at 14s. a day, of £268 16s., or £2 3s. per acre. Where the logging is done thoroughly, as in this case, and the scattered fern, &c., stacked also, the cost of grass-seed works out at 10s. per acre. The basic slag at £4 5s. in Auckland cost £6 per ton landed on the farm, or £1 4s. per acre for a 4-cwt.-per-acre dressing.

Numerous other instances of an application of the methods described in these notes are to be seen throughout North Auckland, and there is every reason to believe that much of the now unprofitable second-class bush country covered in logs, stumps, fern, and scrub will be brought in to profitable dairy pastures by this means.

In conclusion, the writer wishes to record his indebtedness to Messrs. McCullough, who from carefully kept records kindly supplied the figures quoted.

Certificate-of-Record and Official Herd Testing.—The upward trend in number of cows tested under these two systems and number of breeders participating is being maintained. During January, 1929, 665 cows were tested under the C.O.R. system. These were in the ownership of 226 breeders. The corresponding figures for January, 1928, were 186 breeders testing 599 cows. The number of Official Herd Test cows tested during January, 1929, was 1,666, these being in the herds of 128 C.O.R. breeders. This compares with 111 breeders and 1,477 cows for the corresponding month of last year.

SOME EFFECTS OF FERTILIZERS ON THE PRODUCTION OF LUCERNE ROOT NODULES.

W. D. Reid, B.Sc., Mycological Laboratory, Plant Research Station, Palmerston North.

In the establishment of lucerne it is recognized that the formation of root nodules during the growth of the first season is essential for satisfactory results. In some areas in New Zealand artificial inoculation of the seed or soil is not practised—for example, in Marlborough, Central Otago, and Poverty Bay; but in other districts, where the conditions for the growth of lucerne are not so favourable, inoculation of the seed by cultures, or of the area by infected soil, is considered necessary. In all cases, of course, inoculation is required, but in the three districts first mentioned, the grower (perhaps unknowingly) relies upon sufficient inoculation being obtained from the bacteria already present on the seed or in the soil of the area to be sown down.

For a number of years this Laboratory has been supplying farmers with cultures (on agar slopes) for the inoculation of lucerne-seed, and although the results have been very satisfactory a number of cases have occurred in which nodule-production has been negligible or retarded. These same cultures when used in soil tests at the laboratory have given excellent nodule-formation, and the cause of the failure of the field inoculations required an investigation. The laboratory experiments were at first restricted to sowings in soil, the details of farm procedure being followed as closely as possible. Now, in New Zealand it is the custom to mix the seed with the fertilizer prior to sowing, but this fact was not considered in the first experiments. Instead the fertilizer—superphosphate—was sown in drills and the seed sown upon this manure. The obvious results of these sowings indicated the deleterious effect of superphosphate on the germination of the seed, and it was inferred that a similar effect on the nodule bacteria would be produced. This reduction of germination due to superphosphate is well known to those who have studied the effects of manures, and Mr. A. W. Hudson, Crop Experimentalist, suggested the use of the various manures sown with lucerne-seed, together with one of equal parts of superphosphate and lime, a mixture which had been giving good crop results and little loss in germination in Canterbury.

In order to enable a number of tests to be performed without the delay required for the production of nodules on the plants, plating methods were used, in which the viable bacteria after treatment were allowed to produce visible colonies on agar plates.* To eliminate possible contaminations of the plates by bacteria adhering to the seed, sterilization of the seed was required. The usual method of sterilization by dipping in corrosive sublimate (1–1,000) was unsatisfactory, since

* Mannite-agar to which 0·5 per cent. $CaCo_3$ is added. F. Lohnis and N. R. Smith, *Jour. Ag. Research*, Vol. 6, No. 18, p. 686.

FIG. 1. DEMONSTRATING THE IMPORTANCE OF INOCULATING LUCERNE.

Portion of stand on Mr. W. H. Talbot's farm, Pleasant Point, South Canterbury, in October last, ten months after sowing. Foreground—untreated seed: plants yellow and stunted. Background—seed treated with laboratory culture: plants vigorous, with good colour. [*Photo by A. W. Hudson.*

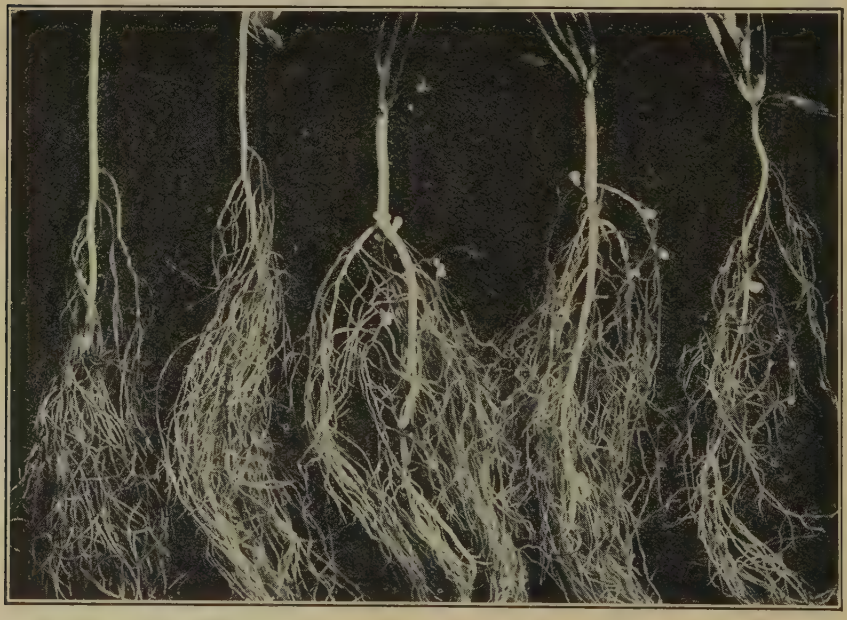


FIG. 2. SHOWING EFFECT OF DIFFERENT FERTILIZERS ON LUCERNE SEED.

The two plants on left are from superphosphate-treated seed; no nodules present on roots. The other three plants are from slag-treated seed; numerous nodules present. All plants approximately two months old.

[*Photo by H. Drake.*

this treatment prevented the growth of the bacteria of the subsequent inoculation, but of the many disinfectants tested ethyl alcohol was found satisfactory.*

The following procedure was adopted in the various tests performed :—

(1) A commercial sample of lucerne-seed of good germination was sterilized by the use of ethyl alcohol, washed in sterile water, and dried.

(2) The inoculation of nodule bacteria was applied to the seed, skim-milk being used for the purpose. Under farming conditions drying does not take more than half an hour, but in the laboratory drying between sheets of sterile absorbent paper occupies about one hour.

(3) The inoculated seed was mixed with the manure to be tested and allowed to remain in contact for half an hour. This period agrees approximately with the time which would elapse under field conditions, but in some tests where the seed was left in the manure for as short a time as fifteen minutes the results agreed with those for the longer periods. Although the quantities of seed and manure were used in the same proportions as for field sowings—14 lb. seed and 3 cwt. manure per acre—this proportion was not essential, as the same result is given by a reduction of the manure to a quantity only sufficient to cover the seed.

(4) After leaving the seed and manure in contact for the desired time, each seed was removed, shaken to remove surplus manure, and then placed upon the surface of the agar-medium plate in the petri dish. Ten seeds were placed on each plate of 3½ in. diameter. Alternate seeds were "wiped" over the corresponding sectors of the plate, and the plate was then incubated for at least seven days at 25° C.

The removal of the surplus manure before plating does not agree with the practice of sowing together the manure and seed on the farm, but such a laboratory method was necessary in order to study the comparative colony growth. In all, fourteen tests were carried out during last year, and a typical result is given in the following table :—

Table 1.

Fertilizer.	Time of Contact of Fertilizer prior to Plating.	Number of Seeds sown on Plates.	Number of Seeds producing Colonies.
Control—no manure and no inoculation	..	10	Nil
Control—no manure plus inoculation	..	10	10
Super A	½ hr.	11	4
Super B	½ hr.	11	5
Basic super	½ hr.	10	All
Super plus lime	½ hr.	10	All
Basic slag	½ hr.	10	All

NOTE.—Supers A and B were obtained from different sources of manufacture.

The table gives for each manure the number of seeds which produced colonies of the nodule bacteria. This result in itself is instructive,

* A paper dealing with a study of some methods of sterilization of lucerne-seed will be published elsewhere.

but a study of the number of colonies produced on the "wiped" areas (see photos) supplies a better method of comparing the various effects.

In the case of superphosphate and basic superphosphate the number of colonies which developed on the wiped areas fluctuated between nil and ten colonies for each area, whereas on those plates which received seed which had been treated with slag the number of colonies was indefinite—that is, more than one hundred per area. In these tests the manures were not sterilized, since it was found that,

FIG. 3. AGAR PLATES OF SUPERPHOSPHATE-TREATED SEED, SHOWING LIMITED DEVELOPMENT OF NODULE BACTERIA COLONIES AFTER TREATMENT.

FIG. 4. ON LEFT, BASIC SUPER TREATED, SHOWING THIRTEEN COLONIES; ON RIGHT, SUPER AND LIME TREATED, SHOWING LARGE NUMBER OF COLONIES, PARTICULARLY ON THE TWO UPPER "WIPED" SECTORS.

[*Photos by H. Drake.*

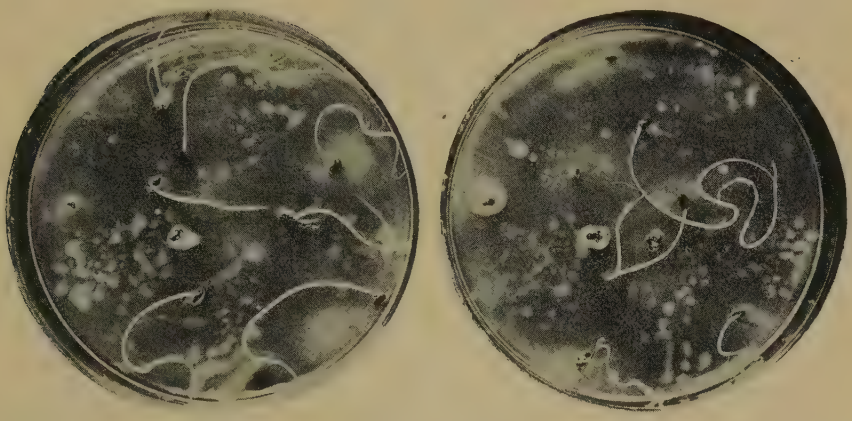


FIG. 5. ON LEFT, NAURU PHOSPHATE-TREATED; ON RIGHT, SLAG-TREATED; BOTH SHOWING EXCELLENT DEVELOPMENT OF COLONIES.

[*Photo by H. Drake.*

with the exception of fungi in the super-lime mixture, they were sterile, or were free from any bacteria which could produce colonies similar to those of the nodule bacteria.

As is indicated by the photographs, the number of colonies produced increase as the basic nature of the manure is increased. No attempt is made herein to propound any theory to account for the results which have occurred.

In addition to the plate tests, soil tests were also made, utilizing the correct seed and manure quantities. The results have been equally striking, even after allowing three months' growth before examination, as was the case with the example shown in the following table :—

Table 2.

Fertilizer.	Germination on 100 Seeds sown per Box.	Number of Plants with Nodules.	Number of Plants without Nodules.
Superphosphate (A)	30	2	28
Superphosphate (B)	25	1	24
Basic superphosphate ..	41	2	39
Superphosphate plus lime ..	53	26	27
Nauru rock phosphate ..	63	50	13
Basic slag	58	52	6

Although all the soil tests are not so consistent in results as are the plate tests a fair agreement is present, and they at least confirm the general conclusion derived from the plating method. Such factors as amount of milk film, age and condition of manure, source of manure, origin of culture, have not been considered in detail, since these factors are masked by the application of the manures. Similarly in the soil

tests variations must occur in the conditions of sowing, particularly conditions of moisture content of the soil, and it is recognized that variations—even under so-called controlled conditions—must result in repeated tests. Under field conditions success has been obtained by the use of superphosphate manures, but in these instances the manure has not been mixed prior to sowing, but "fed" through a separate box, contact taking place between seed and manure during the passage through the coulters. Since this period of dropping through the coulters is very short it is possible for many of the milk-film protected bacteria to survive.

CONCLUSIONS.

These experiments show that where superphosphate fertilizers are mixed with the inoculated seed before sowing the nodule bacteria are killed; and that where rock phosphate or basic slag is utilized excellent results are obtained.

Since this method of applying cultures to the seed is the most satisfactory for New Zealand conditions, it is advisable to refrain from using the "acid" phosphates, or, where such are the only manures available, to sow the seed and manure separately or through separate boxes of the drill.

THE FIREBLIGHT MENACE.

SEVERE EXPERIENCE IN A HAWKE'S BAY ORCHARD.

N. J. Adamson, Orchard Instructor, Hastings.

That fireblight is a real menace to our fruitgrowing industry, particularly to the apple export trade, appears not to be fully realized by the majority of orchardists, more particularly those in districts or localities where fireblight does not exist. Notwithstanding the fact that much has been written and related in connection with fireblight, and instances of severe loss and irreparable damage quoted, we still find people who are sceptical and are inclined to the opinion that an unnecessary scare has been raised by the officers of the Horticulture Division. But seeing is believing, and any one, fruitgrower or otherwise, having had the opportunity of witnessing the loss suffered by several orchardists at Poukawa, in Hawke's Bay, this season could not but become a propagandist in the cause of eradication or prevention of fireblight.

A party of orchardists from Nelson (a fireblight-free district) who recently made a tour of the Hawke's Bay fruitgrowing area were afforded an opportunity of visiting one of these Poukawa orchards and seeing for themselves the havoc wrought by the disease, and came away deeply impressed. The particular orchard inspected consists of 13 acres of apples and pears. Pear-trees, numbering six hundred, comprise Winter Cole, Winter Nelis, P. Barry, Beurre Bosc, and Williams Bon Chretien; the apples are mainly Sturmer, Ballarat, Jonathan, and Delicious.

Investigations revealed that odd fireblight infections appeared on pear-trees in the 1927–28 season, some as blossom-infection, but more

as shoot-infections subsequently. Cutting out was resorted to, but evidently the treatment was not sufficiently drastic, and through several infections not being located a number had travelled into heavier timber, remaining as "hold-overs." Although several such cankers were located, and affected branches and limbs cut out and destroyed during the pruning season, some remained and produced the characteristic ooze at a period coinciding with the blossoming this season. Following a severe outbreak in the orchard, more of these hold-over cankers were located, and were discovered to be oozing. Through the orchardist's inexperience in the matter of cutting out infection, and more particularly in seeking out the dangerous hold-overs, wholesale infection occurred throughout the orchard. As a result of this bud-infection the apple crop on most varieties has been practically wiped out, Sturmer and Ballarat suffering almost a 100 per cent. loss, while Delicious may have a 30 per cent. crop left. Strangely enough, this proportion of loss does not always apply, as the writer has known of instances where Delicious suffered a total loss while Sturmer trees carried a fair crop. Apparently the proportion of loss in any particular variety is light or heavy according to its receptiveness at the time when other conditions for the spread of fireblight are present.

The loss of the apple crop, although severe in itself, is not the only loss as far as the apples are concerned. Owing to the killing of the fruit-buds and spurs only a 50-per-cent. crop can be expected next year,

FIG. 1 (LEFT). BEURRE BOSC PEAR-TREES WITH DISEASED LIMBS REMOVED—TYPICAL OF WHOLE BLOCK IN THE POUKAWA ORCHARD.

FIG. 2 (RIGHT). REMAINS OF A WILLIAMS BON CHRETIEN PEAR-TREE DESTROYED BY FIREBLIGHT. [*Photos by N. J. Adamson.*

FIG. 3. BUD INFECTION OF FIREBLIGHT ON APPLE SHOOT—TYPICAL OF EVERY PORTION OF STURMERS IN THE ORCHARD.

Photo by H. J. Lovell-Smith.

WHEY PASTE AS A PIG-FOOD.*

FEEDING TRIAL AT LINCOLN COLLEGE.

M. J. Scott and R. W. Graham, Canterbury Agricultural College, Lincoln.

Whey as a feed is deficient in protein, fibre, and vitamins. Deficient feeds can be fed to grown animals quite profitably, but when fed to young pigs from weaning up to 60 lb. or 70 lb. weight loss of thrift results. They seldom recover from a check received at this time, and their thrift and subsequent growth is slow and costly. It would appear that inability to carry young pigs over this critical period is at the bottom of most whey-feeding difficulties. Once they pass this critical stage they do fairly well on whey.

Referring to the deficiencies mentioned above, it was considered that the most immediate improvement that could be made was in the protein content by the addition of meat-meal. If this improvement paid for itself there was nothing to hinder the extensive use of meat-meals, since freezing-works are to be found in most whey localities. The first trial was therefore the addition of meat-meal to whey.

Later another trial, using barley (to supply fibre) and meat-meal with whey was started; and although the effect of barley is more than satisfactory, the trial was of little importance, while transport charges make the introduction of barley into whey districts prohibitive.

No information is being collected about the third deficiency (vitamins). It is of some importance where pigs are sty-fed, but since most whey-fed pigs are out on grass it can have little importance in actual practice.

COMPOSITION OF THE PASTE.

The paste supplied to us was solid in some barrels, fluid in others, and fluid above and solid below in others. The average of three samples of each description was as follows:—

Table 1.

	Solid.	Fluid.
	Per Cent.	Per Cent.
Dry matter	58·0	45·0
Protein	6·6	5·2
Chlorides (as NaCl)	2·4	2·1
Acidity (as HCl)	0·7	0·8

The paste had a sickening smell and taste, and was exceedingly bitter. Iron shovels left standing in a solution of whey showed the faintest of copper coatings.

THE FEEDING TRIAL.

The trial here recorded dealt with two lots of pigs, seven in each lot. Both lots were poor and weedy. One lot was fed on whey alone, as much as they could eat; the other had a similar ration, with the

* See article, "The Utilization of Whey," in last month's *Journal*.—Ed.

addition of ½ lb. meat-meal per pig per day, fed separately in dry lot. The pigs were fed inside for thirty days and then outside on a grass-paddock; the trial finished in sixty-three days. While inside the pigs would not eat the paste undiluted, preferring to starve for twenty-four hours, and refusing to eat it even with grain mixed. It was diluted with seven times its weight of water, and troughs kept full with this diluted whey. Lime was added to it at the rate of 1 lb. per 100 lb. of paste. The pigs were put outside as soon as there was any appearance of grass, and tried with solid paste for the third time. This time they ate it readily, and the trial was completed on solid paste.

As is typical with whey-feeding, the pigs scoured very badly, appeared to suffer much from cold, were always shivering, and grew very hairy. In spite of all these things their thrift was very satisfactory — see Table 2, line F (*cf.* Bulletin 2, Scientific and Industrial Research Department, p. 16, Trials 25, 26, 27). The scouring is very objectionable, and it is difficult to give up the opinion that the pigs must do better if scouring were stopped. While feeding the diluted whey we succeeded in stopping it for a while by the addition of burnt lime to the whey, but it came on again when we began to use the paste, probably because it was impossible to mix the lime and paste intimately. The shivering, due to cold weather and the absence of fibre in the paste, was not considered of any importance, since it is not serious in summer weather.

The outstanding feature of the trial not shown in Table 2 is the fact that the whey-alone pigs put on only ½ lb. per pig per day until they were 70 lb. weight. The whey and meat-meal pigs put on just under 1 lb. per day up to the same weight. After 70 lb. weight both lots of pigs put on weight at the same rate—just over 1 lb. per day.

Table 2.

Line.			Whey alone.	Whey and ½ lb. Meat-meal per Pig per Day.
A	Number of pigs		7	7
B	Live-weight at beginning of trial	(lb.)	46·4	52·3
C	Live-weight at end	(lb.)	96·1	113·7
D	Increase per pig	(lb.)	49·7	61·4
E	Days on trial		63	63
F	Average increase per pig per day	(lb.)	0·78	0·97
G	Total increase	(lb.)	348	430
	Feed—			
H	Whey paste	(lb.)	3,118	2,893
J	Equals whey	(gal.)	2,494·4	2,314·4
K	Meat-meal	(lb.)	..	220
L	Total feed (87 per cent. dry matter)	(lb.)	1,732	1,882
	Feed to produce 100 lb. live-weight—			
M	Whey paste	(lb.)	894	672
N	Equals whey	(gal.)	715	537
O	Meat-meal	(lb.)	..	51
P	Total feed	(lb.)	496	423
	Feed per pig per day—			
Q	Whey paste	(lb.)	7·25	6·31
R	Equals whey	(gal.)	5·8	5·09
S	Meat-meal	(lb.)	..	0·50
T	Total feed	(lb.)	4·02	3·65

RETURNS.

As fed in these trials whey alone returned 0·37d. per gallon (gross—no allowance for labour, equipment, &c.) on the basis of pork at 4d. per pound, and 0·559d. per gallon with pork at 6d. per pound. Whey and meat-meal returned 0·37d. per gallon with pork at 4d. and meat-meal £12 10s. per ton, and 0·613d. per gallon with pork at 6d. per pound, and meat-meal as before.

Put in another way, the 220 lb. of meat-meal returned an extra 107 lb. of live-weight, and at 4d. per pound this just pays for the meat-meal. Meat-meal to be profitably used would need to be down to £10 per ton when pork is 4d. Meat-meal, however, keeps pigs healthy and so avoids losses from deaths and lack of thrift. On this score alone it is worth using. It is indispensible with pigs on whey till the pigs are at least 70 lb. weight.

The returns from feeding whey offer no encouragement to those interested in making whey paste. The whey position seems to offer unique opportunities for co-operation between dairy factories and suppliers, such as is practised in other pig-raising communities. If the factories would employ a man and provide equipment in one place at or near the factory to feed one pig per year for every cow supplying the factory, and if each milk-supplier could keep one sow to every ten cows and so supply one weaner per cow each year, even at 4d. per pound for pork, whey would return £1 per cow and the country could turn out 200,000 whey-fed pigs. A man could look after 500 pigs at a time (300-ton factory) quite easily, the whey would be disposed of, and labour and carting equipment dispensed with. We are familiar with the fact that factories have failed in their attempts to use pigs for disposing of their whey, but we are sure that the individual ownership of sows and the use of meat-meal would put an entirely new complexion on the matter.

SUMMARY.

(1) Whey paste diluted was fed to weaner pigs. They drank it quite readily. Later, on pasture, the pigs ate the paste undiluted.

(2) Up to 70 lb. weight the pigs did not thrive on whey alone. After 70 lb. on whey alone, and at all weights with whey and meat-meal, they throve quite readily.

(3) The paste is similar in its effects to ordinary whey.

(4) Meat-meal can be fed profitably with pork at 4d. per pound if the price of meat-meal is not above £10 per ton.

(5) With present prices of pork there does not appear to be any possibility of evaporated whey being a commercial possibility as far as pig-feeding goes.

Electric Drive for Milk-tester.—An Instructor of the Dairy Division reports: "We have had several runs with the new electrically driven Babcock tester, with satisfactory results. The heating-element inside the cover gives plenty of heat and keeps the samples warm, and they are all in good shape for reading when the run is completed. For the first run or two we had a lot of vibration, and it was necessary to get our bench well stayed to overcome this difficulty."

THE SHEEP BLOW-FLY PEST.

Live-stock Division.

THE sheep blow-fly pest is not nearly so much in evidence in New Zealand as in many other countries, such as Australia, but the flies make their appearance during the warmer months in certain districts. The trouble is not entirely confined to summer; it may occur in the spring or autumn if the season is mild and muggy.

Sheep of all breeds are liable to be affected. A certain amount of immunity from attack by the fly is claimed for some breeds. This so-called immunity in all probability is due to the conformation of the breed. Some breeds, on account of the conformation of the hind quarters, are more liable to staining with urine or fæces. The wool in the region of the crutch becomes "daggy," and there is no doubt that such sheep are a greater attraction to the fly than animals clean in that part.

Lambs are very liable to attack before shearing; in fact, in some districts lambs are chiefly attacked, it being unusual to find ewes affected. Otherwise apparently clean sheep are sometimes affected, especially in showery weather. In such cases the fly is attracted to the sheep by the distinct odour arising from the fleece after rain; on account of skin trouble, such as scald; and also from the greater tendency to scour and staining of the hind quarters in showery weather. Any wound, however small, is an attraction to the fly. Shear-wounds, crutching-wounds, sheep affected with foot-rot, are all liable to be struck by the fly. Cast sheep are very liable to become "struck."

The fly deposits its eggs on any stained part of the fleece or on any part of the body showing skin abrasions or irritation. The most common sites, therefore, are the region of the crutch in the ewe, the back, and in the region of the natural openings of the body, especially if there is any wrinkling of the skin. The depression below the eye may be affected in old and weak ewes. Lambs may be affected in the region of the head and neck, as these parts are liable to be stained by the ewes when the lambs suck from behind.

Each fly is capable of depositing a large number of eggs. The eggs hatch out in a few days, assisted by the heat and moisture of the animal's body. The maggots thus formed set up an irritation of the skin which, if not seen and treated, reduces the animal's strength, eventually causing death, the maggots burrowing into the abdomen in advanced cases. The flies are most active after rain, and are capable of flying a considerable distance.

An animal which has been attacked by the fly may show any of the following symptoms. The animal appears to be irritable and uneasy, and when feeding is frequently seen to stamp one hind leg. Often an animal is noticed with its head down close to the ground, but making no attempt to feed, and frequently moving a few paces, to stop and move on again amongst apparently contented sheep. Occasionally the animal may be seen to turn round and bite at its crutch—when that region is struck, as is usually the case. This act of biting at the crutch is seen especially in lambs. In other cases the

animal separates from the flock and seeks the shade of a stump or tree, where it stamps its feet, wags its tail, and turns quickly from time to time, or bites at the struck part as if to dislodge its irritant.

These symptoms are best noted before the sheep are disturbed. Where the maggots are not numerous and only a small patch is affected there is more difficulty in detection. In the latter cases all ewes showing any signs of irritation, staining of the fleece, a jagged fleece from biting or any other suspicious symptoms, should be caught and carefully examined for the presence of maggots. It may be that the wool over an affected part shows a dirty greyish-black stain, which on closer examination will show an unusual blackish exudite, with a peculiarly offensive odour. The maggots will be found at the base of the wool.

Sheep which have been struck require to be treated by hand if only a few are affected, or if a number are affected dipping may be necessary. The maggots should be removed and destroyed, as each is a possible future blow-fly. The affected area requires to be dressed with some antiseptic, as lysol or Jeyes' Fluid. Sheep-dip is commonly employed, but in this connection a non-arsenical dip should be used, as the danger of absorption of arsenic from the wound cannot be overlooked. Provided the wound or damage done by the maggots is not severe, the application of a deodorant will in most cases prevent reinfestation and allow the wound to heal. At the same time the possibility of the animal being struck again in the same region must not be forgotten.

All known measures should be adopted to prevent, as far as possible, the propagation of the fly. Dagging and crutching are universally carried out with the object of preventing staining of the crutch, which is a big attraction for the fly. The dressing of all wounds at shearing is done mainly with the same intention. So far no preparation has been found which can be used as an application to permanently ward off the attacks of the blow-fly. Arsenical powder dips have given as good results as any others as a preventive.

In districts where the fly is prevalent efforts should be made to eliminate all possible breeding-grounds. All carcasses of dead animals should be buried or burned, the latter course being preferable. Offal from animals killed on the farm should be destroyed by burning, even rabbits receiving attention.

Dr. D. Miller, now entomologist to the Cawthron Institute, has for some time been engaged on research work in connection with parasites of the blow-fly. Several Inspectors of Stock are co-operating with Dr. Miller in the liberation of the parasites at present available. The united effort of all farmers in districts where the fly has made its appearance is essential in order to reduce or eradicate this pest as far as possible.

Rimless Cheese.—The amending regulations under the Dairy Industry Act, 1908, gazetted on 21st December last, include a clause requiring cheese for export to be rimless after 31st July next. Cheese with a rim not deeper than $\frac{3}{8}$ in. will be considered as rimless. Factories still using old-style hoops thus have ample time to get into line.

FARMERS' PASTURE COMPETITIONS.

NORTH TARANAKI RESULTS, 1928.

E. BRUCE LEVY, Agrostologist, and J. M. SMITH, Instructor in Agriculture, New Plymouth.

THERE is perhaps no better practical method of carrying on field investigation and demonstration work of immediate practical value to the farming community than that afforded by field competitions. The excellent work among root and fodder crops as the outcome of competitions initiated and conducted by Mr. J. W. Deem, Fields Superintendent, has opened up the advisability of extending these competitions to New Zealand's great staple crop, its grasslands.

In comparison with roots, hay, and ensilage crops, where weight of crop is made the prime scoring factor, the judging of grazed pastures, often situated remote from one another, presented considerable difficulty in the awarding of points. However, the application of a technique recently devised by the Department of Agriculture, has resulted in a reliable method of assessing awards, based on botanical composition of the pasture, and hence quality of herbage produced. Botanical composition is fundamental as regards the quality and production of pastures. The botanical composition of a sward, the associating of species one with another, is an analysis in itself of the sum environmental conditions under which that sward is asked to grow. The grassland association, then, is but the response to the environmental conditions that are natural to or are artificially set up on those soil-types we endeavour to grass, and a measure of the association, or the botanical composition of the pasture sward, taken in relation with our knowledge of the factors that produce that association, give us a reliable method of assessing awards to a grazed sward. The point-quadrat method of pasture-analysis affords this measure.*

In addition to botanical composition, there is the all-important point of utilization of herbage produced. Recent research work and practical experience go to show that the same plant varies in food value according to its stage of growth. Young, comparatively short, even-growing, leafy herbage, irrespective almost of what species of pasture-plant we choose, is more palatable and richer and better balanced in the essential milk-production ingredients than is the case when that herbage becomes older or of rank growth. Hence in judging pastures this point of utilization is extremely important, and in this the eye is a fairly reliable instrument for measuring.

Actually botanical composition also reflects utilization. Among our pasture species there are top grasses and bottom grasses. Perfect utilization maintains a balance between the two groups. Close continuous grazing eliminates from the sward virtually all top grasses, such as cocksfoot, timothy, and red clover; while the production of rank feed tends to eliminate from the sward the bottom grasses, such as

* This method consists in making a large number of pin-point quadrats at equally spaced intervals throughout the pasture, recording storey by storey the species of vegetation within each quadrat.

rye-grass, crested dogstail, and white clover. Our experiences in the past have convinced us that that pasture which runs dominantly to and is maintained dominantly in perennial rye-grass and white clover reflects optimum sward-production conditions. These are: (1) High soil-fertility upkeep; (2) perfect soil-drainage—soil not too dry nor yet too wet; (3) efficient aeration, the outcome of drainage and surface cultivation; (4) spread of manure and avoidance of rank, patchy development; (5) perfect utilization of herbage products, by which is set up the correct light-and-shade relationship within the sward, and assuring high nutrient content of herbage consumed.

In summing up the results of botanical analyses, therefore, perennial rye-grass and white clover score the highest individual points. The points allotted for each species (see tables) are more or less arbitrary—that is, they are not based on actual measured production from each individual species; but in this arrangement of points we have endeavoured to show as accurately as possible the relative values of those pastures wherein dominance is attained by any one particular species or set of species. Thus we consider a dominant rye-grass and white-clover pasture approximately two and a half times better than one in which Yorkshire fog and brown-top are dominant, and some ten times as high in production as where such plants as sweet vernal, catsear, rib-grass, &c., are dominant. Further, this grading of species gives credit or otherwise for the actual conditions for pasture-plant life reflected in what the soil-type is supporting. Thus, if a soil-type can only support a sweet vernal, catsear, and rib-grass dominant association we know that that country is starved and poorly farmed, and that this is the best Nature can do under the existing conditions. It impresses a much-needed lesson—recognition of the fact that botanical composition reflects exactly the conditions under which the sward is asked to grow. This system of awarding points penalizes the poor-conditioned soils and encourages the effort to improve, for so surely as we improve, so more and more of the high-scoring species will appear in the pasture.

A difficulty that exists in almost all field competitions lies in awarding so that credit is given to the farmer for crops or pastures produced on naturally infertile soils. It would seem imperative that a classification of soil-types, measured largely by the natural volunteer grass sward that such soil reverts to in an unimproved condition, should be made prior to any comprehensive competition scheme.

So far as the areas in the competitions under review are concerned, the soil-type throughout is fairly uniform and may be classified as naturally sweet vernal, catsear, and rib-grass dominant, running ultimately to Danthonia pilosa dominant. This soil-type is by no means first-class country in the unimproved state, and it appears that annual or twice-a-year applications of artificial manures will be necessary to bring it up to the rye-grass and white-clover standard of soil-fertility. Be this as it may, from an examination of the analyses contained in the accompanying tables it will be seen that the winning farmers are getting near the mark, while others have yet a long way to go. The point we wish to make here, however, is the necessity of classifying the soil-types so that any improvement that has been effected may be strictly comparable and be given credit within the group offering in the competition.

Competition, Lepperton, 1928: Details of Botanical Analyses, Marks gained, and Place in Competition.

Name of Species.	J. N. Blyde.		W. D. Cartwright		F. T. Crowe.		A. N. McLeod		H. E. Blyde.		W. A. Cartwright.		C. J. Olliver.		H. Woisen.		W. N. Ackland.		W. D. Foreman.		Dem. Farm, Stratford.	
	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.
Bare ground ..	9·25	0	5	0	4	0	5	0	4·25	0	4·75	0	5·75	0	4	0	4·50	0	7·50	0	6·75	0
Perennial rye-grass ..	26·00	260·00	10·25	102·50	27·50	275·00	5·25	52·50	9·75	97·50	29·75	297·50	20·75	207·50	28·25	282·50	29·50	295·00	5·50	55·00	64·50	640·00
White clover ..	17·25	172·50	12·25	122·50	25·00	250·00	6·00	60·00	19·50	195·00	10·00	100·00	7·50	75·00	7·25	72·50	27·75	277·50	11·00	110·00	21·50	215·00
Cocksfoot ..	5·50	44·00	10·00	80·00	6·75	54·00	8·75	70·00	10·50	84·00	6·00	48·00	5·00	40·00	4·75	38·00	6·75	54·00	12·25	98·00	19·50	156·00
Crested dogstail ..	2·50	20·00	11·00	88·00	12·25	98·00	2·25	18·00	2·75	20·00	5·00	40·00	10·50	84·00	1·00	8·00	8·75	70·00	0·50	4·00	7·25	58·00
Timothy ..	..	..	0·25	2·00	0·75	6·00	..	..	0·25	2·00	0·75	4·00	0·50	4·00	..	..	0·50	4·00	0·75	6·00	2·75	22·00
Poa trivialis ..	1·50	12·00	0·25	2·00	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Red clover ..	0·25	2·00	2·00	16·00	..	..	3·75	30·00	1·50	12·00	..	..	0·25	2·00	0·50	4·00	0·50	4·00	..	..	..	..
Poa pratensis ..	25·00	150·00	10·00	60·00	5·75	34·50	12·50	75·00	11·50	69·00	9·25	55·50	5·75	34·50	11·75	70·50	6·25	37·50	22·00	132·00	9·50	76·00
Suckling clover ..	0·25	1·00	25·75	103·00	4·75	19·00	42·00	168·00	6·50	26·00	21·00	84·00	6·75	27·00	21·00	84·00	12·25	49·00	3·75	15·00	0·25	1·50
Lotus major ..	0·25	1·00	..	..	1·50	6·00	7·50	30·00	4·25	17·00	..	..	3·75	15·00	..	..	..	..	1·50	6·00	1·75	7·00
Brown-top ..	..	..	..	..	4·00	16·00	1·75	7·00	0·75	3·00	0·25	1·00	..	..	1·25	5·00	0·75	3·00	15·50	62·00	..	..
Yorkshire fog ..	4·75	19·00	5·25	21·00	4·50	18·00	9·75	39·00	9·00	36·00	18·00	72·00	9·75	39·00	15·50	62·00	14·75	59·00	0·75	3·00	16·25	65·00
Ratstail ..	..	..	..	..	0·25	0·50	6·25	12·50	..	..	..	..	..	..	..	..	0·25	0·50	0·25	0·50	..	..
Danthonia pilosa ..	..	..	..	..	..	..	0·25	0·50	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chewings fescue ..	..	..	1·25	2·50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Knee-jointed foxtail ..	6·25	12·50	5·75	11·50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Goose-grass ..	..	..	..	..	..	..	0·50	0·50	..	..	1·50	1·50	..	..	0·25	0·25	0·25	0·25	..	..	..	..
Hair-grass ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·25	0·25	..	..	0·75	0·75	..	..
Sweet vernal ..	15·50	15·50	16·00	16·00	16·75	16·75	11·00	11·00	18·25	18·25	19·75	19·75	18·50	18·50	15·25	15·25	12·50	12·50	..	..	..	..
Catsear ..	5·75	5·75	18·75	18·75	33·00	33·00	14·00	14·00	38·50	38·50	13·00	13·00	23·75	23·75	23·25	23·25	23·75	25·75	16·25	16·25	1·50	1·50
Rib-grass ..	14·50	14·50	28·50	28·50	15·00	15·00	10·75	10·75	19·50	19·50	12·25	12·25	23·00	23·00	19·75	19·75	16·00	16·00	17·25	17·25	1·50	1·50
Dandelion ..	..	..	..	..	1·00	1·00	0·75	0·75	1·00	1·00	2·25	2·25	3·25	3·25	..	..	0·25	0·25	18·75	18·75	0·50	0·50
Hawkweed ..	..	..	0·75	0·75	0·50	0·50	1·75	1·75	1·25	1·25	1·00	1·00	2·00	2·00	3·00	3·00	2·50	2·50	0·50	0·50	..	..
Slender chickweed ..	..	..	..	..	1·50	−1·50	1·25	−1·25	0·75	0·75	0·50	0·50	0·50	0·50	1·50	1·50	0·25	0·25	2·25	2·25	0·50	0·50
Creeping buttercup ..	0·50	−0·50	2·75	−2·75	..	..	0·75	−0·75	0·50	−0·50	0·50	−0·50	..	..	..	..	..	..	1·50	−1·50	0·50	−0·50
Veronica agrestis ..	..	..	0·50	−0·50	0·25	−0·25	..	..	..	..	..	..	..	..	0·50	−0·50	..	..	1·00	−1·00	..	..
Australian flax ..	..	..	0·50	−0·50	..	..	..	..	4·25	−4·25	1·00	−1·00	1·00	−1·00	1·50	−1·50	1·25	−1·25	0·75	−0·75	0·75	−0·75
Selfheal ..	..	..	1·00	−1·00	1·50	−1·50	3·00	−3·00	..	..	1·00	−1·00	..	..	..	..	..	..	2·25	..	0·25	−0·25
Geranium molle ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·25	−0·25	..	..	..	..	..	..
Field daisy ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·75	−0·75	..	..	..	..	0·25	−0·25
Yarrow ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total hits per 100 points	125·75	..	162·75	..	162·50	..	149·75	..	160·25	..	152·75	..	142·50	..	157·50	..	164·75	..	135·00	..	149·25	..
Total marks for species	..	729·25	..	670·25	..	840·00	..	596·25	..	636·00	..	749·75	..	598·00	..	686·75	..	909·75	..	544·00	..	1,243·75
Utilization (max. 100)	..	100·00	..	20·00	..	80·00	..	100·00	..	60·00	..	70·00	..	90·00	..	80·00	..	90·00	..	70·00	..	100·00
Grand total marks ..	..	829·25	..	690·25	..	920·00	..	696·25	..	696·00	..	819·75	..	688·00	..	766·75	..	999·75	..	614·00	..	1,343·75
Place in competition ..	..	3rd	..	8th	..	2nd	..	6th	..	7th	..	4th	..	9th	..	5th	..	1st	..	10th	..	..

NOTE.—For scale of marks allotted per hit per species see last column of Table 2.

Table 2.—Pasture Competition, Tikorangi, 1928: Details of Botanical Analyses, Marks gained, and Place in Competition.

Name of Species.	J. Paulger.		F. C. Blyde.		H. P. Sarten.		H. Foreman.		D. Griffiths.		R. Rolfe.		T. Hine.		C. S. Carmichael.		R. McKenzie.		J. Vickery.		Marks allotted per Hit per Species.
	Average Hits per 100 Points examined.	Marks gained by each Species	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	Average Hits per 100 Points examined.	Marks gained by each Species.	
Bare ground ..	3·75	0	5·25	0	5	0	6	0	4·75	0	5·50	0	3	0	6·25	0	2	0	6	0	—
Perennial rye-grass ..	21·75	217·50	23·50	235·00	15·50	155·00	22·25	222·50	9·25	92·50	10·75	107·50	33·00	330·00	11·25	112·50	49·50	495·00	19·00	190·00	10
White clover ..	15·25	152·50	18·75	187·50	24·75	247·50	15·75	157·50	29·00	290·00	5·25	52·50	17·00	170·00	6·25	62·50	7·00	70·00	11·25	112·50	10
Cocksfoot ..	17·00	136·00	1·25	10·00	9·75	78·00	12·50	100 00	10·00	80·00	10·25	82·00	7·60	60·80	4·75	38·00	13·50	108·00	3·50	28·00	8
Crested dogstail ..	..	..	1·00	8·00	..	..	0·50	4·00	0·75	6·00	6·25	50·00	7·30	58·40	..	..	4·75	38·00	13·00	104·00	8
Timothy ..	..	..	..	..	2·75	22·00	..	..	1·50	12·00	..	..	2·00	16·00	..	..	0·25	2·00	..	..	8
Poa trivialis ..	..	..	..	..	..	..	..	..	1·00	8·00	0·25	2·00	..	..	..	..	9·50	76·00	..	..	8
Red clover ..	..	..	..	..	..	..	..	..	0·25	2·00	..	..	..	..	0·25	2·00	..	..	..	..	8
Poa pratensis ..	15·25	91·50	11·00	66·00	9·25	55·50	11·50	69·00	14·50	87·00	16·25	97·50	6·60	39·60	8·25	49·50	7·00	42·00	8·75	51·50	6
Paspalum ..	..	..	..	..	..	..	..	..	0·50	3·00	..	..	..	..	..	..	..	..	0·50	3·00	6
Suckling clover ..	5·50	22·00	2·25	9·00	3·75	15·00	0·50	2·00	8·25	33·00	25·25	101·00	32·60	130·40	40·25	161·00	0·75	3·00	13·75	55·00	4
Lotus major ..	..	..	..	..	..	..	..	..	2·00	8·00	7·00	28·00	2·00	8·00	..	..	0·25	1·00	..	..	4
Brown-top ..	..	..	1·75	7·00	0·25	1·00	0·25	1·00	..	..	0·25	1·00	2·60	10·40	2·25	9·00	8·25	33·00	12·75	51·00	4
Yorkshire fog ..	5·25	21·00	4·75	19·00	6·25	25·00	13·75	55·00	5·50	22·00	7·50	30·00	11·00	44·00	11·75	47·00	2·75	11·00	7·50	30·00	4
Ratstail ..	..	..	0·25	0·50	..	..	..	..	..	..	0·50	1·00	2·00	4·00	2·00	4·00	..	..	1·00	2·00	2
Danthonia pilosa ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4·75	9·50	..	..	..	..	2
Chewings fescue ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·25	0·50	..	..	2
Creeping bent ..	..	..	0·50	1·00	..	..	..	..	7·25	14·50	..	..	..	..	..	..	..	..	..	..	2
Poa annua ..	1·00	1·00	1·75	1·75	0·50	0·50	0·25	0·25	0·25	0·25	..	..	..	..	..	..	1·25	1·25	0·25	0·25	1
Goose-grass ..	..	..	0·25	0·25	..	..	..	..	..	..	0·25	0·25	..	..	..	..	4·00	4·00	..	..	1
Hair-grass ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·25	0·25	4·25	4·25	0·50	0·50	1
Sweet vernal ..	35·00	35·00	29·00	29·00	27·50	27·50	21·75	21·75	11·75	11·75	17·50	17·50	14·00	14·00	19·75	19·75	22·75	22·75	17·00	17·00	1
Catsear ..	18·25	18·25	18·50	18·50	22·25	22·25	14·25	14·25	26·25	26·25	22·50	22·50	17·30	17·30	25·50	25·50	9·50	9·50	23·00	23·00	1
Rib-grass ..	18·50	18·50	16·00	16·00	11·00	11·00	15·00	15·00	12·75	12·75	15·00	15·00	18·60	18·60	24·75	24·75	14·50	14·50	9·75	9·75	1
Dandelion ..	..	..	1·00	1·00	0·50	0·50	..	..	0·50	0·50	0·50	0·50	..	..	..	..	0·50	0·50	0·50	0·50	1
Hawkweed ..	1·50	1·50	3·00	3·00	5·75	5·75	0·25	0·25	4·00	4·00	1·25	1·25	..	..	0·75	0·75	1·00	1·00	0·75	0·75	1
Greater plantain ..	..	..	..	..	..	..	..	..	0·50	0·50	..	..	..	..	..	..	..	..	..	..	1
Slender chickweed ..	0·75	—0·75	1·00	—1·00	1·50	—1·50	1·25	—1·25	2·00	—2·00	..	..	0·60	—0·60	1·25	—1·25	7·75	—7·75	0·25	—0·25	—1
Creeping buttercup ..	..	..	0·25	—0·25	0·75	—0·75	..	..	2·50	—2·50	..	..	..	..	..	..	0·25	—0·25	..	..	—1
Cudweed ..	..	..	1·50	—1·50	0·50	—0·50	..	..	..	..	0·75	—0·75	..	..	0·25	—0·25	..	..	..	..	—1
Selfheal ..	..	..	1·50	—1·50	1·00	—1·00	1·25	—1·25	0·50	—0·50	0·50	—0·50	4·30	—4·30	0·75	—0·75	0·25	—0·25	..	..	—1
Sagina ..	..	..	..	..	..	..	..	..	0·75	—0·75	..	..	..	..	..	..	..	..	—0·25	—0·25	—1
Field daisy ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—1
Lotus hispidus ..	..	..	0·25	0·50	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Veronica agrestis ..	..	..	0·25	—0·25	0·25	—0·25	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—1
Total hits per 100 points	155·00	..	139·25	..	143·75	..	131·00	..	151·50	..	147·75	..	178·50	..	165·00	..	169·75	..	143·25	..	..
Total marks for species	..	714·00	..	608·50	..	662·50	..	660·00	..	708·25	..	608·25	..	916·60	..	563·75	..	929·00	..	678·25	..
Utilization (max. 100)	..	100·00	..	90·00	..	50·00	..	90·00	..	100·00	..	50·00	..	10·00	..	40·00	..	60·00	..	100·00	..
Grand total marks ..	..	814·50	..	699·50	..	712·50	..	750·00	..	808·25	..	658·25	..	926·60	..	603·75	..	989·00	..	778·25	..
Place in competition ..	..	3rd	..	8th	..	7th	..	6th	..	4th	..	9th	..	2nd	..	10th	..	1st	..	5th	..

The outstanding features of the pastures as shown in these analyses are: (1) The predominance throughout of the low-production species—sweet vernal, catsear, and rib-grass—as compared with normal high-class pasture;* (2) the comparatively unimportant place occupied by cocksfoot, timothy, and red clover; (3) the high Poa pratensis content, which in many cases far exceeds that of cocksfoot and crested dogstail; and (4) the variation in rye-grass and white-clover content as an outcome largely of different standards of soil-fertility set up.

It will be obvious to readers that many of the pastures entered are not really up to competition standard. In fairness to these, due allowance must be made for the fact that entries were not called for until late, and that many of the best fields were then shut up for hay or ensilage. The real object of the competition, however, is to enable a farmer to know his pasture, and to help towards that improvement which will lead ultimately to the ideal—a perennial rye-grass and white-clover dominant pasture.

In conclusion we would like to point out that these are the first pasture competitions held in New Zealand, and we wish to convey our appreciation to the farmers of Lepperton and Tikorangi districts for the enthusiastic way in which this matter was taken up by their respective branches of the Farmers' Union. Due acknowledgment is also made to Messrs. E. A. Madden and C. Haynes for assistance with the pasture analyses.

* For comparative purposes we have included in Table 1 (last columns) a high-class ten-year-old pasture at the Stratford Demonstration Farm.

STATISTICS OF FARM MACHINERY AND ENGINES.

FOLLOWING is a summary of farm machinery and engines employed on rural holdings (outside borough boundaries) in New Zealand for the past five years:—

Class of Machinery, &c.	1924.	1925.	1926.	1927.	1928.
Milking-plants	14,553	15,561	16,391	17,090	18,049
Cream-separators	42,473	44,656	45,765	45,246	45,246
Shearing-machines—					
Plants	5,480	5,728	5,949	6,305	6,518
Stands	17,844	18,445	18,797	19 269	19,677
Wool-presses	8,035	8,601	8,641	8,832	9,504
Agricultural tractors	512	1,026	2,025	2,588	2,883
Reapers-and-binders	15,048	15,881	15,574	15,287	15,432
Threshing-machines	332	377	361	364	406
Chaffcutters	2,970	2,903	2,865	2,562	2,326
Water-wheels or motors ..	871	846	817	784	932
Electric motors	2,587	3,451	6,356	8,436	10,806
Steam-engines	626	622	473	435	505
Internal-combustion engines ..	18,864	19,894	19,584	18,885	18,321

—*Census and Statistics Office.*

WEEDS AND THEIR IDENTIFICATION.

THREE COMMON DOCKS (*RUMEX* spp.).

ESMOND ATKINSON, Department of Agriculture, Wellington.

THE Second Schedule of the Noxious Weeds Act includes automatically all species of the genus *Rumex* that are found in New Zealand. Strictly speaking, this would involve two native and six introduced docks, as well as sorrel proper and sheep's sorrel. Most of these, however, are not common enough to be agriculturally important, while the commonest and most important of all (sheep's sorrel) is only botanically speaking a "dock." Only three species will therefore be illustrated in this article—broad-leaved dock (*Rumex obtusifolius*), curled or narrow-leaved dock (*Rumex crispus*), and Maori dock (*Rumex flexuosus*).

The following is a key to give a rough idea of the differences between these three species :—

(1) Tall upright plants several feet high, with long tap-roots :—
  (*a*) Lower leaves several inches wide, base heart-shaped, margins flat .. .. .. *R. obtusifolius.*
  (*b*) Lower leaves much narrower, lance-shaped, margins very much waved .. .. *R. crispus.*
(2) Plant with much smaller tap-root and leaves, and straggling wiry-looking stems .. .. .. *R. flexuosus.*

The docks belong to a family of plants, known botanically as the *Polygonaceae*, which for its size includes few that are useful—rhubarb and buckwheat being the best known of these latter. In New Zealand there are several members of this family, besides the sorrels and docks, that are important weeds—for example, wire weed (*Polygonum aviculare*) and smartweed (*Polygonum Persicaria*). The latter was described and illustrated under the name of "lady's thumb" in the *Journal* for January, 1928.

BROAD-LEAVED DOCK.

Probably the commonest of the docks, and according to G. M. Thomson ("The Naturalisation of Animals and Plants in New Zealand") certainly the most so in the South Island, is the broad-leaved dock. It was first reported not far from a hundred years ago, though there is often doubt about the accuracy of these early identifications. At any rate, this species and curled dock are now among the most abundant weeds of pastures on the heavier soils, and both make a great show along damp roadsides and in waste places.

Broad-leaved dock is a perennial, up to 1 yard or more in height, with a strong and deeply penetrating dark-coloured tap-root (carrots and parsnips are typical examples of tap-roots), and abundant root-leaves with long stalks and dark-green blades 1 ft. or so in length and several inches wide, with heart-shaped bases, blunt tips, and crinkled but not waved edges. Leaves are very often seen the same size as those illustrated (Fig. 1 (*b*)), but in luxuriant plants they are perhaps twice as big. There may be a number of stems from one root, but as a rule they do not branch much except at the tops, where the flowers are

FIG I. BROAD-LEAVED DOCK (RUMEX OBTUSIFOLIUS).

(*a*) Fruiting shoot, natural size; (*b*) leaf, natural size; (*c*) fruit, magnified; (*d*) seed, natural size and magnified.

[*Drawing by Esmond Atkinson.*

FIG. 2. CURLED DOCK (RUMEX CRISPUS).

(*a*) Fruiting shoot, natural size; (*b*) leaf, natural size; (*c*) fruit, magnified; (*d*) seed, natural size and magnified.

[*Drawing by Esmond Atkinson.*

borne. They have small scattered leaves which are quite unlike those described, being much narrower in proportion and with short stalks or none at all.

The way the flowers are carried in long finger-shaped spikes is shown in Fig. 1 (*a*). The clusters of flowers round the axis may be so close as to make the spike a continuous one, or they may be far enough apart to show quite a lot of the stem. The amount of exposure to light, &c., is the factor that causes these differences in the appearance of individual plants. The flowers themselves have not been shown in the drawing, but only the young and ripe fruits, which have features that make them the surest way of telling one dock from another.

It is worth getting some idea of the structure of the flower, which consists of six segments — three inner and three outer (Fig. 1 (*c*)). After the actual flowering is over and the "seed" begins to ripen (only one is borne by each flower) the inner segments enlarge with the growing of the seed and continue to enclose it. In many of the docks these coverings become very strongly coloured with various reds, purples, and browns, and make the whole plant very showy, but in shadier places they often stay quite green.

The appearance of the fruit in broad-leaved dock is shown in the illustration, and the differences between the fruits of this species and curled dock will be pointed out later. The "seed" is shown at Fig. 1 (*d*). It is triangular in section, brown-coloured, and shiny.

CURLED DOCK OR NARROW-LEAVED DOCK.

This species need not be described in so much detail as the last, but the chief differences will be pointed out. It has the same type of root, but the root-leaves (Fig. 2 (*b*)) are strikingly different in being only about half the width, gradually tapering at the tip, and with very strongly waved edges—whence the name "curled dock." There is not much difference in the size and general appearance of the stems or in the flowers. What distinguishes the two plants at once is the shape of the seed-coverings (Fig. 2 (*c*)). The illustration will make this clear. In broad-leaved dock each of the three segments is roughly triangular, and has several conspicuous teeth along the sides. In curled dock the segments are broader, more or less heart-shaped, and without any teeth along the edge. In both species there is in the middle of the segment a nodule or tubercle, which ends abruptly in curled dock and tapers into a vein in broad-leaved dock. The "seeds" of the former are much the same, but are rather shorter and wider.

MAORI DOCK.

This is often called "native dock" or "rolling dock." There is no question of any confusion between this species and the two common introduced ones just described. It has a small perennial tap-root, and—compared with the other two—quite small root-leaves, which are often more or less brown in colour and sometimes show a trace of the characteristic shape of a sorrel-leaf. The stems are not stiff and upright, but branch from the base and sometimes straggle for several feet through other vegetation.

FIG. 3. MAORI DOCK (RUMEX FLEXUOSUS).

(*a*) Lower portion of plant, natural size; (*b*) fruiting shoot, natural size; (*c*) fruit, magnified; (*d*) seed, natural size and magnified.

[*Drawing by Esmond Atkinson.*

The name " rolling dock " is given from the fact that in open country the tangled mass of stems often breaks off when the seed is ripe, and is blown over the surface of the ground for quite long distances. The illustration (Fig. 3 (*c*)) shows a most characteristic feature of the seed-covering—namely, the hooked spines, which are analogous to the barbed spines of piripiri and serve the same purpose in seed-distribution. As a matter of fact, the specimens from which the drawing was made were growing within a few inches of plants of the large purple piripiri (*Acaena novae zelandiae*) and the Australian burr (*Acaena ovina*) — a curious coincidence if all three were not brought there by the same means.

Maori dock is widely spread in all types of country from sea-level to 4,000 ft. It is not found anywhere except in New Zealand, but is related to an Australian species.

OTHER INTRODUCED SPECIES.

It is possible that there may be some little confusion between those described and one or other of the remaining introduced species of *Rumex*.

Fiddle dock (*Rumex pulcher*) is frequent in fields and waste places. It has leaves of the shape indicated by its common name.

Clustered dock (*Rumex conglomeratus*) is found in the same situations, but is less common. It has rather leafy stems, and seed-coverings with almost entire edges like those of curled dock.

Red- or green-veined dock (*Rumex sanguineus*) is another fairly common species, with two forms—a red and a green veined one—the latter being much the more common here. It has seed-coverings of the same toothless type as those of curled and clustered docks.

Sheep's sorrel (*Rumex acetosella*) is well enough known to every one. The true sorrel (*Rumex acetosa*) is sometimes mistaken for it, but is rather larger and is without creeping underground stems.

POSITION AS WEEDS, ETC.

There is little to be said about control methods. Generally speaking, the aggressiveness of the docks as weeds lies in their power of sending out new shoots from the perennial tap-roots when these have been cut off. Hilgendorf (" Weeds of New Zealand ") refers to the use of a sprinkle of ammonium sulphate, and mentions further that it has the advantage of being a valuable fertilizer to grasses. Common salt is sometimes used in a similar way on lawns, &c.

The seeds of docks are very frequent impurities in lines of agricultural seeds. E. Bruce Levy (*Journal*, Feb., 1915) says that curled-dock seeds are found chiefly in lucerne, broad-leaved in cocksfoot.

New Zealand Institute Fellowships.—At the annual meeting of the Board of Governors of the New Zealand Institute held at Auckland last month, Dr. G. H. Cunningham (Plant Research Station, Palmerston North), and Dr. J. Henderson (Geological Survey), were elected Fellows of the Institute.

SEASONAL NOTES.

THE FARM.

TOP-DRESSING AND PASTURE MANAGEMENT.

Rye-grass, after being practically dormant in January and February, usually starts its autumn growth in March and grows on into early June. Early autumn top-dressing increases the rye-grass growth in the late autumn and early winter, and thus helps to increase the winter carrying-capacity of grassland.

On sheep-farms where the stock-carrying capacity is entirely limited by the winter growth of grass, fertilizers for top-dressing should be applied in March or early April. This is very necessary if the ewe stock on the farm is to be increased, so that the cost of fertilizers may be recovered and a profit obtained on the top-dressing. On dairy-farms top-dressing pays through increased butterfat-production, even though the number of cows milked may not be increased; on sheep-farms, although the cost of the fertilizers may ultimately be recovered from increased production of wool and a higher percentage of fat lambs, without greatly increasing the number of sheep carried, it is usually necessary to carry more ewes to obtain an immediate return from the application of fertilizers and thus render top-dressing a profitable practice. This is particularly true for moderately good grassland being top-dressed for the first time. For unless the stocking is increased to cope with the greatly increased grass-growth which occurs the following spring the grass may get ahead of the sheep and the lambs do badly. On quite poor surface-sown grassland, however, it may take two or even three applications of phosphatic fertilizers before the stock-carrying capacity of the grassland is greatly increased. Another advantage of early top-dressing on hill country is that it allows the best use to be made of fine weather. Later, when the hills become wet and slippery, great difficulty is often experienced in getting the material on the ground, and the cost of applying is materially increased.

On dairy-farms the commencement of the autumn growth of rye-grass is usually reflected in a slight rise in butterfat-production in late February and early March, and this rise is followed by a gradual decline as the herds are dried off. Early autumn top-dressing is now becoming fairly common on dairy-farms, and it is a practice that helps to increase the winter carrying-capacity of the grassland. The milking of late-calving cows through the winter is now usual, and a reasonable winter production from these cows can only be obtained if a fair grass-growth is available for feeding in addition to the ordinary rations of hay and roots, or hay and silage. Phosphatic fertilizers, particularly superphosphate, have proved beneficial in increasing the autumn growth of grass, and it remains to be seen whether a much larger growth may not be obtained from nitrogenous fertilizers in addition to the ordinary application of phosphates. Applications of nitrogen in the winter have proved beneficial in increasing the spring growth of grass, but spring and summer applications of nitrogen have been rather disappointing.

Before pastures are top-dressed in the early autumn all rank growth should be grazed or mown off, and the field thoroughly chain- and tripod-harrowed as soon as the droppings have been sufficiently softened by rain to render them easy to spread.

CROP-PRODUCTION.

Grassland intended for wheat should be skim-ploughed before the middle of March. After skim-ploughing the furrows should be left unbroken for a month or six weeks to allow the turf to rot, and the land then disked so that the turf is thoroughly broken up before deep ploughing. The two ploughings of grassland for wheat are very necessary in order to allow the vegetation to decay and to obtain a fine firm seed-bed.

Special catch-crops of oats or barley for winter and spring green feed should be sown in March or early April. At one time cereal catch-crops for spring green feed were fairly common on dairy-farms, but with the gradual improvement of dairying grassland their use has declined. Any cultivated land, however, that will not be used till the spring can well be sown in oats or barley for winter and spring feeding. Green cereals provide very desirable feed for milking-cows in the late winter and early spring, and the light land common to most dairying districts is better occupied by a crop than left fallow over the winter. On dairy-farms where the pastures are predominantly rye-grass it is probable that early spring feed will be more cheaply provided by the application of nitrogenous fertilizers to grassland than by special catch-crops of green cereals.

Red clover is usually cut for seed about three months after the hay crop. When the clover-seed can be rubbed out from the majority of the heads and the stalks begin to lie at an angle of 45 degrees it is time to cut.

The linseed crop will be ready for harvesting early in March. The crop is ready to cut when the cobs, if rubbed between the hands, open easily and shed the seed. The crop should be allowed to remain in the stook till dry; this will take from two to three weeks. The crop is most conveniently threshed from the stook.

AUTUMN-SOWING OF PASTURES.

March is usually the best month for sowing permanent and temporary pastures on ploughed land. Sowing in February is often unsatisfactory owing to the uncertain rainfall; in years of good rainfall, however, February sowings do remarkably well. The seed-bed for sowing grass should be fine and firm from top to bottom. The cultivation operations should be finished with a rolling, and the seed and fertilizer broadcast on the rolled surface. The seed can then be covered with a stroke of light tine or chain harrows, and the land finally rolled again. The mixtures used for permanent pasture naturally vary with the soil-conditions and climate. Standard mixtures suitable for various conditions are given in the Department's Bulletin, No. 107, "Grasslands of New Zealand." Advice required about grass mixtures for particular conditions should be sought from the district Instructors in Agriculture.

—P. W. Smallfield, B.Ag., Fields Superintendent, Auckland.

SHEEP-DIPPING.

Loss of condition in a flock is caused sometimes through parasites such as lice and keds (commonly spoken of as ticks). Constant scratching and biting and rubbing against posts and fences are the most common symptoms. A lice-infected animal cannot do justice to the food it eats. The staining of the fleece from parasites reduces its value considerably. Apart from the fact that the animal thrives better, the fleece is improved in value by dipping.

If the sheep are infested with lice a double dipping is essential to thoroughly eradicate the parasite. The first dipping kills off the living vermin, but those which hatch out from the eggs during the next ten days remain, so that the second dipping, to be effective, requires to be carried out within fourteen days. The louse is a small parasite and requires to be carefully looked for, otherwise it may escape notice. It lays a large number of eggs, which are attached to the wool-fibres.

Practically all the standard dips on the market to-day are suitable if the mixing of the dip is carried out strictly to instructions supplied on each packet or drum of the dip used. One of the most common causes of failure is insufficient immersion. Each sheep should be held for at least one minute in the bath, with two minutes for long-woolled sheep. The head should always be immersed.

Dipping in a dirty bath reduces the strength of the dip. The bath should be cleaned out at proper intervals, and the following rules also observed: (1) Avoid dipping in wet weather; (2) measure accurately the bath-water; (3) dissolve the powder thoroughly before using; (4) mix the dip properly; (5) keep stirring the bath; (6) use the dip full strength.

FLUSHING THE BREEDING-EWES.

On fat-lamb-raising farms in the North Island the rams are usually put out at the end of February or early in March. Flushing, by feeding the ewes on some succulent feed for a week or ten days before the rams go out, helps to increase the lambing percentage. Flushing can be done by running the ewes on rape after the first feeding-off by the lambs, or, where there is no rape, on the best pastures available.

—Live-stock Division.

THE ORCHARD.

FRUIT-MARKETING.

THE work of harvesting and marketing the main portion of the fruit crop will now be requiring the concentrated effort of every commercial orchardist. In most instances consideration is being given to both local and export markets. Fortunately, the export grading and packing is supervised and standards adhered to. Fruit for the local market, however, providing it is free from disease, is still allowed to be distributed without restriction as regards grade. No doubt growers who have engaged in export have improved their local market standard of pack and grade. Nevertheless large quantities of low-grade fruit flood the local markets, with the inevitable low price.

It is fully agreed that the quantity of low-grade fruit going on the local market has a very dulling effect, and that such fruit, hardly realizing sufficient to cover expenses, seriously affects the profitable disposal of good lines and interferes with the demand.

The question arises as to what class of fruit should be treated as low grade and not marketed as fresh fruit. The next problem is the profitable disposal of this undergrade fruit. Fruit must be considered of low grade or unfit for the market if immature or undersized. These two faults may be rectified—first by refraining from picking fruit till sufficiently mature. Making several pickings, each time with a careful selection, helps in this direction. The quantity of undersized fruits may be brought down to a negligible quantity by careful and adequate thinning and care in picking, avoiding the picking of undersized fruit. Small fruit will generally come up to size if left for a time after the tree has been relieved of its load.

Diseased fruit—that is, fruit affected chiefly with conspicuous black-spot, San Jose and other scales, and codlin-moth (or, in the absence of moth, numerous strings)—is fruit which should be rejected, being of low grade. Fruit heavily russeted, carrying conspicuous blemish in the way of branch rubs, cracks, beetle marks, &c., is all low grade and is not sought after. Unfortunately, some growers have too much of the undersized, diseased, and blemished fruit and feel tempted to market it. They then wonder why fruit brings such a low price and the orchard is not profitable.

The solution to the question is not so much in finding a means of profitably disposing of low-grade fruit other than selling it as fresh fruit—as this only gives encouragement to its production—but in bringing about an improved general condition of orchards by encouraging the growing of better-quality fruit, and in bringing down the quality of rejects to a level when an orchardist can dump this fruit or feed it to pigs without regret. The chief factors in profitable fruit-production which the grower may control are cultivation, manuring, thinning, disease-control, and pruning. All these are governing factors in the maintenance of health and vigour in the tree, which is essential. Pests and diseases which have a debilitating effect on the tree through injury to foliage should be fought strenuously; often they receive little attention.

Having produced good marketable fruit and used discretion in harvesting the crop, the need for some care in preparing for market should receive consideration. The maintenance of a good standard of grade and pack, the use of clean new cases, and an attractive "get up" will secure more for the grower than an article put up in a slovenly manner.

SOME FURTHER EXPORT POINTS.

The few hints in regard to export matters given in last month's notes may be supplemented by a few general outstanding points in connection with the actual preparation of fruit for export. Colour standards must be rigidly maintained, even if the general run of fruit is lacking in colour. There is always a marked tendency to fall short as regards the colour standard on a dull line of fruit. Graders should occasionally make an examination of fruit in the bins to check

up their grading. Grade and pack should not be sacrificed for speed. The size of fruit should be uniform throughout a case; larger-sized fruits should not be used to bring up a low case, as this interferes with the pocketing and causes bruising. Corrugated strawboards are preferable to the ordinary cardboard pads for such varieties as Cox's Orange. Faulty cases should be discarded. Nails should be not less than 14 gauge and 1½ in. in length. Paper of correct size should be used. Extreme care should be exercised in marketing cases—giving correct particulars. Wood-wool, where used, should not protrude from ends of lids. Marks on labels should be distinct and put on neatly. Red, violet, and green inks fade quickly; a black ink is preferable—care being taken to keep the pad sufficiently moist but not wet.

SPRAYING AND OTHER ORCHARD WORK.

The actual work in the orchard for the coming month will consist mainly in spraying late varieties of apples and pears with arsenate of lead for the control of codlin-moth and leaf-roller caterpillar, using 1¾ lb. to 100 gallons of water. Leaf-hopper may still prove troublesome, necessitating the application of Black Leaf 40, 1–800. Red mite may have increased considerably where lime-sulphur has not been the standard fungicidal spray throughout the season. Recently attention has been given to the use of special summer oils, chiefly for the control of such pests as red mite. Where such oils are procurable growers would be well advised to carry out tests on a small scale, and thus become acquainted with their use and effects. Ordinary spraying-oils have been applied at varying strengths in the summer with satisfactory results, and may be safer in their application than reverting to lime-sulphur on trees where red mite has reduced the vitality of the tree to any extent. Oil, 1–100, has been applied with safety, and to avoid a spotting of the fruit which may sometimes occur the addition of 4 lb. to 5 lb. of soap is recommended.

Trees should be looked over frequently for the purpose of adjusting props, putting in extra ones and tying to prevent, as far as possible, breaking of limbs and splitting of crotches. Consideration should be given to the necessity of permanently wiring-up trees. Possibly the work may be fitted in during the winter months, but in the meantime it will be wise to give the matter a little thought.

In connection with intended plantings and replacements it is now well to look ahead, and, having decided on varieties, place orders early.

Trees grafted in the spring should be looked over, and ties not already cut dealt with immediately to prevent any restriction in the sap. New growths often require some protection to prevent them being blown off by wind.

FIREBLIGHT.

There is still danger of fireblight infection occurring on shoots, which may lead to infection of main limbs, more particularly in

the case of pear-trees. Such varieties as Williams Bon Chretien and other varieties picked early may require an inspection occasionally.

—N. J. Adamson, Orchard Instructor, Hastings.

Citrus-culture.

From now on fruit-picking will form the chief current work. As the fruits become ready they should be removed from the trees and put in suitable storage for curing. The best period to harvest lemons is as soon as sufficient size has been attained and the leaf-green of the fruits gives place to silver-green. Fruits should be cut from the trees with one of the types of cutters designed to permit easy working without danger of piercing the rind. Really two cuts are necessary in harvesting lemons—one to sever the fruit with footstalk attached from the tree, and the second cut to trim the stalk back flush with the button, and so avoid the stem-puncture so common among fruits in the cases.

Fruits which have turned yellow, even though small, should be removed from the tree; allowing them to remain will not increase their size, juice contents, or market value. The main alterations which take place in such tree-refined fruits are increased colour of rind, fibrousness of ray and cell sacs, and development of stored food in pips. This is the factor which acts to the real detriment of the tree, as an unnecessary strain is put on its functioning. As fruits are harvested they will be found on three types of wood: (1) Young laterals with tip-flower extensions; (2) one-year-old laterals somewhat extended, worn out towards the extensions, but showing a vegetative shoot nearer the base; (3) two-year-old laterals very extended and worn out generally.

There are modifications, but these types serve to represent the necessary pruning to be done, which may with advantage be carried out at harvest-time when each individual fruiting lateral comes under close observation. (1) Young laterals may be left uncut, unless they are in an undesirable upright position or too numerous for what is considered the capability of the tree. (2) One-year-old laterals should be cut back beyond the worn-out part to a good bud on healthy green wood, or to a vegetative growth if present. (3) Two-year-old laterals should be cut out clean to the base. Even if there are not sufficient of types (1) and (2) to give an assured season's crop, profit will never come from laterals of type (3), which have become an encumbrance to the tree, many through not having been cut back as recommended for (2), and which otherwise would have given rise to useful side shoots. It is usually found that worn-out trees are hampered by a multitude of spent laterals. Should such be the case it is preferable to cut these laterals back to the base and keep the framework of the tree, rather than cut back the main limbs.

A general renovation of this kind gives more fruiting type of wood than the severe cutting, but it is of course more desirable to keep up a relay of wood such as is brought about by proper and regular attention to laterals at each fruit-picking time.

—W. H. Rice, Orchard Instructor, Auckland.

POULTRY-KEEPING.

CULLING.

THE present high cost of foodstuffs, and the probability of having to accept lower prices for poultry products as compared with prices received during recent years, are sufficient indications that the poultry-keeper cannot afford to have on the plant any bird that will not produce heavily in the future. The coming month may be regarded as the best period of the year for culling out undesirable stock. In the first place every hen that shows signs of moulting and terminating its second season of production (with the exception perhaps of any noted breeding-specimens) should be weeded out without delay. Indeed, under existing conditions, drastic culling should take place in the majority of flocks after the pullets' first laying season. The day for keeping all birds for two years is past.

The culling of undesirable stock is one of the chief essentials in successful poultry-keeping. Of all operations connected with the business it is probably the most difficult to teach the novice properly by means of printed matter. However, to the man who is not a student of laying-form it may be pointed out that useful indications of poor laying-capacity in hens are early moulting, over fatness, and being above the normal weight of the breed; also any signs of weak constitution—such as dull eye, loose feathering, sluggish appearance, and lack of abdominal development—and anything denoting unhealthy condition.

The birds which have laid well and which are likely to do so in the future will present the following desirable signs of constitutional vigour and laying-power: Late moulting; face large and free from feathers (it is not uncommon for the head to become quite bare—a sign seldom or never found in a low producer); a bright prominent eye; close feathering; a bright red comb; a well-developed abdomen, which should be soft to the touch, a well-developed crop, and an alert, vigorous, but shabby appearance.

In yellow-skinned breeds the legs as well as the beaks of the good layers will mostly exhibit at this period of the year a bleached or even a white appearance, while, on the other hand, those of the poor layers will retain a more or less yellow colour. It may be mentioned that the legs of even the best layers will not become bleached out to the same extent when a grass range is provided as when they are kept in confinement. Here, as is the case with all matters connected with the management of poultry, local conditions must be taken into account when applying this test. The same may be said with regard to taking the time of moulting as a guide to productive capacity. It will be usually found that in a mixed flock of first- and second-season layers the latter will, owing to their shorter season of production, moult later than those in their pullet year. Therefore, in the work of culling due allowance for the age of the bird must be made, otherwise many of the young birds which it would be profitable to keep are apt to be disposed of, and their older but less profitable sisters retained in the flock.

In order to simplify the work of culling, all young birds should be marked in the web of the foot by a special punch made for the purpose.

EARLY MATURITY.

On a recent visit to a poultry plant the owner drew my attention to two lines of White Leghorn pullets of the same age—near five months—which were purchased from two different breeders as day-old chicks, and which had received similar treatment in all respects. In the case of one line the owner was high in his praises, merely because some of them had commenced to lay at such an early age. With the others both the stock and their breeder were condemned, as in this case the birds gave little indication of even nearing the laying stage.

It is to be feared that there are too many poultry-keepers who hold the mistaken idea that early maturity necessarily indicates heavy productive powers. It is true that some strains of the same breed, when subjected to similar treatment in every respect, will commence to lay at an earlier age than others, but this does not necessarily mean that the very early maturing bird is the most profitable to keep, nor has it yet been proved that such stock are desirable specimens to breed from.

As a general rule, when a pullet commences to lay she will not make further growth. Obviously her energy will be diverted to egg-production and not to bodily development—this meaning that the bird will never reach the standard size of its breed, nor will it lay a desirable-sized egg as does the bird which comes to lay when fully developed. For a bird to be a long-season layer of good-sized marketable eggs she should not commence her season of production until she is well developed and has reached an age of at least six months, and even that period may be extended in the case of the heavier breeds. It is not the age at which a bird commences to lay, but the number of eggs of good marketable size she will produce in two years and possess at the same time desirable breeding-power that determines her real value. The small egg is one of the greatest drawbacks confronting the industry to-day in the establishment of a sound export trade, and it is not the bird which comes to lay when it is little more than half-grown that will tend to improve matters in this respect.

SELECTING THE BREEDING-HENS.

If a uniform, heavy-producing flock is to be bred and maintained, it is of the first importance that nothing but purebred stock be placed in the breeding-pens. In doing this the poultry-keeper should be familiar with the characteristics of the breed or breeds he is working with. In other words, he must have an ideal type in his mind's eye, in addition to signs indicating productive capacity. Those who are not familiar with breed-type would be well advised to procure a copy of the New Zealand Utility Poultry Standards, obtainable from the Department of Agriculture, Wellington, at a cost of 3s., postage free. This contains plates showing breed-type combined with utility.

Having secured purebred stock and eliminated the drones from the flock, as previously advised, it must not be assumed that all the remaining birds on the plant are suitable for the breeding-pen. In selecting the best hens for this purpose it is not so much the egg-yielding capacity that should be studied as the power to produce desirable

progeny. It is always a good plan to choose for the breeding-pen a hen slightly larger than that desired in a laying-flock. The small birds will come soon enough without specially breeding for them. Unfortunately, too many poultry-keepers consider that because small birds are often good layers they must necessarily be desirable specimens for the breeding-pen. This is a great mistake, and the less it is practised the better will it be for the poultry-keeper's pocket and the industry generally. Furthermore, less would be heard of the necessity of having to unload small-sized eggs on to the London market. It should always be remembered that, as a general rule, the diminutive hen produces a low-grade egg. No hen should be placed in the breeding-pen which does not produce a standard-weight egg—namely, one of 2 oz.

I would again emphasize the importance of weeding out all inferior stock at the earliest possible moment, and also of selecting the breeding-stock, for the reason that the signs referred to as indicating high or low egg-capacity will vanish with the moulting process.

—F. C. Brown, Chief Poultry Instructor, Wellington.

THE APIARY.

FINAL EXTRACTING.

BEFORE taking the last of the surplus honey a careful examination of the colonies must be made in order to ascertain the amount of stores available for wintering the bees. Too often beekeepers err in extracting too closely, and feeding has to be resorted to at a later period to make up the amount required to prevent starvation. It takes 30 lb. of honey to winter a colony successfully, and if this amount is increased to 40 lb. there is less likelihood of the bees being short in the spring, while the beekeeper will also be saved a great deal of anxiety and endless trouble in the way of feeding.

Where extracting has been delayed for any reason it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care must be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A rapid examination of the brood-chamber should be made in case it is found that the bees have not filled the combs in the lower storey with honey. If empty or partly filled combs are found, it is highly important that they be replaced with good combs of honey from the super. On no account attempt to extract any honey from the brood-chamber. Do not leave combs lying about or expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to start the bees robbing in a wholesale manner.

EXTRACTED COMBS.

It is very bad practice to put extracted combs on the hives as soon as the honey is taken from them. If returned during the day in all likelihood robbing may be started, and, moreover, the

bees will become troublesome as they seek an entrance to the honey-house. The wet combs should be placed on the hives in the evenings, as the bees will have time to clean them during the night, and any excitement caused by the return of the combs will have subsided by morning. Owing to the labour involved in carrying out supers of combs, placing them on the hives, then freeing the combs of bees, and finally returning them to the honey-house, many beekeepers make a practice of storing wet combs. Although no definite research work has yet been undertaken to determine whether the following season's honey is affected by combs stored in this manner, it lends suggestions to a very doubtful procedure, for not only do the moist atmospheric conditions promote fermentation of the honey in the combs, but in the course of time honey-houses become permeated with the injurious bacteria of fermentation, while the sour smell engendered cannot be considered in any other light than detrimental to the keeping-qualities of a well-ripened honey.

It may be well to remind beekeepers that many lines of honey, while not actually sour or in a fermented condition, possess the characteristic odour so very noticeable in rooms used for storing wet extracting combs. The keeping-qualities of such honey are regarded as doubtful, and it is rejected for export. While beekeepers may be producing the maximum crops attainable under the season's conditions, the after-care of the honey, once in the storage-tanks, presents quite a number of problems, not the least important of which is the preservation of its natural aroma.

BEE-ESCAPES.

For removing honey late in the season the beekeeper may find it necessary to bring into use bee-escapes. These escapes enable the honey to be removed without causing any disturbance. By the employment of the Porter bee-escapes there is less likelihood of causing robbing, with its attendant evils. More especially will the escapes be found advantageous when removing section honey from the hive. There is far more risk in removing comb honey from the hive than extracted honey. When the colony is disturbed the bees will at once start to fill their sacs, and often the cappings of the sections are punctured in order to secure a supply of honey. The damage to the cappings of sections is unsightly, and causes the honey to leak after removal from the hive.

The best escape device is made in the form of a frame 20 in. long, 15 in. wide, by 3 in., which is covered by wire gauze, and one or two escapes fitted into it. In inserting the escape gently prize up the super from the brood-chamber and insert the board. A puff of smoke will suffice to control the bees while the operation is being performed. If this is done late in the afternoon the bees will pass through the escape during the night to the brood-nest, and will be unable to return. In the morning the supers may be removed, when practically no bees will be left in the super.

A word of caution to those who have not formerly used the escapes: Should there be brood in the super combs the bees will not leave, and the escapes will not prove effective in ridding the

supers. Over and over again many beginners complain that they cannot get the bees to leave the supers when using escapes; but the reason lies in the fact that no examination had been made to ascertain beforehand whether the super contained honey only.

UNITING COLONIES.

Among the autumn work to be attended to is the examination of the colonies for the purpose of ascertaining if each possesses a laying queen, and to note those that are too weak to survive the winter. In the negative in either case it is advisable to unite with a stronger colony to save the bees. On no account should an attempt be made to winter weak hives, as they are likely to get robbed out, and this may cause the bees to start robbing generally when everything in the apiary should be quiet.

—E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

THE TOBACCO CROP.

THE later tobacco crops will now be ripening, and the leaf should be gathered as soon as the middle leaves on the stalk show the requisite signs of ripeness. An early harvest has the additional advantage of warm curing-weather, which is a great facility. This advantage should be taken by carefully observing the ripening process and the weather, and accepting the best conditions offering without delay.

Give the leaf careful consideration while it is air-curing; ventilation and humidity must be carefully watched throughout the process. In rough weather the ventilators will require to be closed down to avoid chilling and bruising the leaf; in warm close weather more ventilation will generally be required. This is often deficient in the gables of the roof, and many barns would afford much better results if more ample ventilation were available there. The worst dangers threaten later in the season, when cold damp weather is experienced. The leaf must be kept warm, and any temperature much below 60° F. will cause mildew and decay.

When the leaves are cured and thoroughly dried out the plants must be taken down and the leaves stripped from the stalk, graded, and tied in "hands." The grading must be done in accordance with market requirements. Keep the grades separate and tie the leaves —fifteen to twenty together—by the stems in a bunch (hand), with a leaf of tobacco folded bright side outermost. Commence binding with the tip and finish by bringing the butt of the stem of the binder back close up to the binding between the layers of the hand of leaves. Most important is it that the leaf is in a soft pliable condition when this or any other handling process is carried out. Much damage is done every season by handling leaf in a dry state, when it breaks easily, and its value is heavily discounted. The dry leaf absorbs moisture very readily, and if by means of steam or some other method a humid

condition is created the requisite condition of the leaf is very quickly brought about, after which it may be handled without damage.

As the leaf is graded and made up into hands it can be bulked ready for baling up later. During this stage, if it is likely to be exposed to cold or drying conditions, it should be wrapped in waterproof covers. Tobacco is a very sensitive product, and the fine qualities are only developed and retained when it is handled with care.

BERRY FRUITS.

In some cases this season numbers of strawberry-plants have borne little fruit, owing to debility caused by an absence of good normal foliage that is so necessary for the proper functioning of the plant. Leaf-spot (*Mycosphaerella*) has so increased that the whole of nearly every leaf is discoloured and curled, till the whole plant is a tight bunch of bronze-coloured foliage. This may be readily avoided by periodical sprayings during the early summer months with bordeaux. Such a spray will also do very much towards cleaning up the plants generally, and assist in reducing the fruit-rot that is sometimes too prevalent. Berries found affected in this way must not be thrown on the ground, but should be collected when picking and destroyed. Excessive moisture due to atmospheric conditions or lack of drainage are the conditions that encourage the development of this mould.

With the harvest season over the cleaning-up of the beds should be carried out without delay, and such spraying as needed should be done. Loganberries, like raspberries, should have the old fruiting-canes and weak shoots removed. The fruiting-canes for next season may then be given any necessary spray treatment required, tied in, and ripened in readiness for another season. All of these summer-bearing berry plants should now be put into good heart during the autumn months.

TOMATOES.

Among the outside tomato crops one or two cases of "early blight" have been observed. Fortunately this disease is not general, but it is rather stubborn to deal with when found. We are now told that the fungus known as *Alternaria* is not the causal organism, as has been stated, but is incidental. This disease is to receive more attention shortly from those who make a special study of fungi, and we may look forward to more enlightenment as to the ways of this troublesome organism, which may lead to a more effective method of preventing the serious damage for which it is sometimes responsible.

MARKET-GARDEN CROPS.

Perennial crops such as rhubarb and asparagus should now be making strong growth, and if they are also well protected from severe winds this condition should promise well for the spring crop.

The winter crops of savoy cabbage, cauliflower, broccoli, leek, and celery planted out in January have had good weather and should now be well advanced. They are all crops that like generous treatment, and where any are backward a little sulphate of ammonia or nitrate may be given to stimulate growth.

Commence to mould up the main-crop celery for blanching. The soil must be friable and the plants free from surface moisture. Draw the mould only a few inches high at first, and increase it after a week or ten days, making about three operations of the process. Where small quantities in trenches are being grown see that the needs of the plants in the way of food and water are well supplied before moulding up is commenced.

Cabbage crops for spring cutting are planted out towards the end of March, or rather later in northern districts. For this crop an area from which potatoes or peas have been recently harvested is very suitable. Light cultivation is all that is needed, and when the surface is even and firm mark it out into shallow drills and set out the plants. A dressing of lime will be of great assistance, and help to keep the plants from the attack of pests. In fact, if the plants are sprayed while in the seed-beds with bordeaux and arsenate of lead they will be well protected from insects as well as fungus enemies.

The big onion crops in this country are grown on the fine, rich, light soils of the drained swamps of North Canterbury, where the rainfall is light; and also to a considerable extent on the warm slopes of Pukekohe Hill, near Auckland. In such localities the dry climate enables spring-sown crops to ripen and be harvested in good condition, but in districts with a heavier rainfall, or where a dry autumn cannot be relied on, it is the practice to gain time by sowing the seed in the autumn, planting it out in early spring, and so bringing the crop to maturity in the drier summer months instead of the late autumn. The crop thus finishes in better condition, and is less liable to losses from mildew disease. Seed may be sown now on a piece of clean well-drained soil. Firm the ground and sow thinly.

Feed late crops of peas, and runner and dwarf beans, &c., so that there may be no delay in bringing them into bearing while there is time to take a crop from them before winter.

THE HOME GARDEN.

In most districts garden-making or alterations are best completed during the present month, and preparations made for planting trees and shrubs in the months of May and June. Grass-seed sown now will make a nice sward before the winter; or where turf is laid it will quickly establish itself. A good application of blood-and-bone manure, turned well in, makes an excellent dressing, and where grass-seed has to be sown or turf laid the ground must first be made evenly firm and the surface smooth, special care and plenty of time being given to such preparation. Avoid depressions and hollows that will hold surface water; in fact, care should be taken to see that the surface inclines in such a manner that all flood water is conveniently led away. For that reason level lawns are difficult, and should only be made when specially required for games. In this manner green lawns, which are by no means the least attractive feature in the garden, may now be established with the least trouble and best chances of success. Sow thickly; 1 oz. of seed of ordinary lawn mixture to 2 sq. yd. is a suitable quantity.

—W. C. Hyde, Horticulturist, Wellington.

TESTING OF PUREBRED DAIRY COWS.

JANUARY CERTIFICATE-OF-RECORD LIST.

Dairy Division.

FIFTY-SEVEN certificates were issued under the C.O.R. system in January. Details of the records are given in the following list:—

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Waipiko Joy Queen ..	C. G. C. Dermer, Waipiko	1 304	240·5	365	10,185·8	604·00
Waipiko Clandestine	C. G. C. Dermer, Waipiko	1 282	240·5	365	11,477·6	573·60
Likeness Dainty ..	H. N. Svendsen, Pukekohe	2 82	248·7	365	10,278·4	517·49
Waipiko Coral ..	C. G. C. Dermer, Waipiko	1 327	240·5	365	8,367·8	462·20
Greendale Molly ..	R. J. Johnston, Runciman	2 68	247·3	365	7,671·6	455·67
Croydon Princess Joan	W. Crosby, Waipuku ..	1 354	240·5	352	8,109·6	440·52
Vernon Golden Freezia	D. J. Cooper, Masterton ..	1 330	240·5	365	8,670·2	438·21
Masterful's Remembrance	A. Devine, Tamahere ..	1 288	240·5	365	8,939·7	434·40
Marshlands Coral ..	W. J. Chynoweth, Pukeroro	1 292	240·5	365	7,319·0	423·13
Lady Hignett ..	Mrs. M. North, Ohaupo ..	2 72	247·7	324	7,460·4	389·23
Huimai Miss Prim ..	J. Nicholson, Manakau ..	1 359	240·5	340	8,593·9	388·38
Woodlands Lady Effie	H. C. Sampson, Hillsborough	1 337	240·5	365	7,191·3	381·58
Marshlands Expectation	W. J. Chynoweth, Pukeroro	2 17	242·2	364	7,061·1	375·65
Silverleys Oxford Rita	J. S. Jones, Bell Block ..	2 42	244·7	318	6,053·6	359·93
Jersey Lea Petal ..	R. C. Leach, Woodville ..	2 11	241·6	365	6,464·6	340·45
Silverleys Lady Viola	J. S. Jones, Bell Block ..	2 3	240·8	319	5,644·3	337·44
Senior Two-year-old.						
Vernon Golden Lily ..	D. J. Cooper, Masterton ..	2 331	273·6	365	9,244·3	522·38
Ribbonwood Nettie ..	C. G. Bloore, Gisborne ..	2 346	275·1	282	5,776·6	277·48
Three-year-old.						
Waipiko Cosmetic ..	C. G. C. Dermer, Waipiko	3 304	307·4	365	10,595·1	622·87
Silverleys Malaprop ..	J. S. Jones, Bell Block ..	3 356	312·6	365	9,311·7	578·35
Silverleys Oxford Wonder	J. S. Jones, Bell Block ..	3 4	277·4	302	8,226·4	492·65
Ohape Lavender ..	H. W. Birch, Roxburgh ..	3 32	280·2	365	6,028·5	381·82
Huimai Podge ..	J. Nicholson, Manakau ..	3 33	300·3	243	7,944·8	333·11
Holly Oak Comedy Queen	L. A. McDonald, Levin ..	3 247	301·7	189	6,344·8	331·70
Four-year-old.						
Falconite Pansy ..	G. E. Yelchich, Waiuku ..	4 27	316·2	365	11,383·9	593·54
Vernon Cherry Bloom	G. R. and H. Hutchinson, Auckland	4 331	346·6	365	10,806·1	584·27
Waipiko Jewel ..	C. G. C. Dermer, Waipiko	4 242	337·7	350	10,299·6	582·97
Queen Myrtle* ..	W. Craig, Waiuku ..	4 164	329·9	365	11,605·8	578·50
Swan's Fox's Fancy	D. J. Cooper, Masterton ..	4 183	331·8	361	10,676·2	545·67
Vernon Rata ..	D. J. Cooper, Masterton ..	4 264	339·9	365	10,024·3	537·04
Woodlands Lily ..	H. C. Sampson, Hillsborough	4 285	342·0	365	10,021·3	524·03
Tauwhare Princess ..	Dr. C. G. Aickin, Auckland	4 21	315·6	364	9,595·0	510·91
Waipiko Casuarina ..	C. G. C. Dermer, Waipiko	4 321	345·6	365	9,587·9	481·60

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS—*continued.*						
Mature.		Yrs. dys.	lb.		lb.	lb.
Marshlands Leno ..	T. Smith, Otorohanga ..	5 14	350·0	365	12,044·7	701·38
Waipiko Lorna ..	C. G. C. Dermer, Waipiko	7 299	350·0	365	13,634·0	672·08
Yarrawa's Girl ..	J. S. Jones, Bell Block ..	8 302	350·0	365	10,452·0	604·35
Holly Oak Sage Queen	T. A. Jennings, Mauriceville	6 216	350·0	365	11,226·9	587·75
Cid's Distraction ..	Dr. C. G. Aickin, Auckland	6 207	350·0	364	7,487·1	478·38
Vernon Fuchsia ..	D. J. Cooper, Masterton ..	5 62	350·0	278	8,418·6	450·30
Meadowvale Empress	L. A. McDonald, Levin ..	6 44	350·0	189	6,715·7	354·55
FRIESIANS.						
Junior Two-year-old.						
Echo Sylvia Pietertje Topsy*	Fraser and Kirkness, Waikiwi	2 22	242·7	333	13,809·1	465·37
Pareora Hero Posch*	A. S. Elworthy, Timaru ..	2 136	254·1	297	13,168·6	440·19
Totara K. P. Lena Lass 2nd*	Piri Land Co., Auckland	2 69	247·4	326	13,835·3	437·16
Senior Two-year-old.						
Wescoll Natalie* ..	Wesley Training College, Paerata	2 355	276·0	365	12,615·3	510·52
Totara Paula Kate*	Wesley Training College, Paerata	2 270	267·5	365	11,663·1	436·70
Dominion Queen Crest	Central Development Farm, Weraroa	2 334	273·9	365	11,530·0	377·95
Mature.						
Daisy Segis of Norfolk Park*	Wesley Training College, Paerata	9 229	350·0	365	20,792·5	649·92
Pareora Janette* ..	A. S. Elworthy, Timaru ..	7 70	350·0	365	19,666·2	616·37
Bainfield Sylvia Ideal*	C. H. Potter, Pukerau ..	5 338	350·0	365	17,551·9	578·51
Dominion Krugersdorp	Central Development Farm, Weraroa	7 37	350·0	365	14,894·6	474·00
AYRSHIRES.						
Two-year-old.						
Elims Kowhai ..	A. R. Claridge, Toko ..	2 170	257·5	250	7,780·7	323·22
RED POLLS.						
Two-year-old.						
Dominion Beulah ..	Central Development Farm, Weraroa	1 356	240·5	365	7,598·7	300·01

Second-class Certificates.

Jerseys.

Junior Two-year-old.						
Ku Ku Virtue ..	F. Phillips, Otorohanga ..	1 355	240·5	365	9,052·1	488·21
Tyntesfield Eunice ..	R. K. Garland, Okauia ..	1 355	240·5	365	7,217·6	473·93
Three-year-old.						
Waiora Charm ..	A. E. Peppercorn, Cambridge	3 48	281·8	365	9,023·8	441·91
Mature.						
Willowbank Wonder	J. S. Jones, Bell Block ..	9 356	350·0	365	11,105·7	574·11
Friesians.						
Junior Two-year-old.						
Totara Busate Rose*	Piri Land Co., Auckland ..	2 25	243·0	365	15,413·7	611·08

WEATHER RECORDS: JANUARY, 1929.

Dominion Meteorological Office.

GENERAL NOTES.

JANUARY was a month of contrasts, a hot spell in the third week being followed by a cold snap of almost wintry severity. Rainfall was considerably below average in the North Island and the western districts of the South Island, but in Canterbury and Otago an excess was generally recorded. Once more there was an unusual frequency of thunderstorms, many of which were severe. In some cases these storms were accompanied by downpours resembling miniature cloudbursts. Some remarkable hailstorms also occurred, considerable damage being done in a number of instances.

The storm systems were mainly centred far south, and of only moderate intensity. In consequence, the prevailing weather was of the westerly type, and the storms affected principally the South Island. High-pressure centres continued to follow unusually far-northward tracks for the season of the year, but were seldom of any great intensity.

The deficiency of rainfall, following on the heavy rains of December, was not enough in the North Island to affect pastures adversely, and feed is everywhere abundant. The rankness of the growth has in places adversely affected the raising of fat lambs, but stock is on the whole in good condition. The hot, dry weather preceding the 20th was a boon to harvesters and hay-makers, and satisfactory results are generally reported. Some crops have been flattened by wind, hail, or rain, but fungus diseases have made much less headway than was feared.

A very severe hailstorm, in which stones up to 2 in. in diameter were seen to fall, visited Otago on the 7th during the passage of a low-pressure wave. A number of crops were totally destroyed and other damage was done. On the 8th a deep depression was centred south of Tasmania, the Hobart barometer reading 28·96 in. North-westerly gales were experienced in and south of Cook Strait on this day and the next. On the 10th a terrific thunderstorm, accompanied by torrential rain, occurred near the Hermitage, some miles of road being washed out.

The week ending on the 19th was very hot, many places in the South Island recording over 90° F. In the North, though temperatures were not so high, the great humidity rendered conditions no less oppressive. Hawke's Bay, however, appears to have escaped much of the severity of this heat wave.

The hot spell was followed by a period of southerly winds, which gradually increased in force and brought lower and lower temperatures. An anticyclone was centred over the Tasman Sea, while pressure fell very low to the eastward. On the afternoon of the 23rd Chatham Islands reported a barometer reading of 28·78 in. The southerly winds began to reach gale force in places on the 22nd, but did not attain their full strength until the night of the 24th and the morning of the 25th. Most districts then experienced gales, but from Cook Strait southwards on the east coast they were exceptionally severe. The high winds, accompanied by high tides and a heavy swell, caused unusually rough conditions. Shipping was delayed and some vessels reported damage. Some of the eastern suburbs of Christchurch were flooded, and the Wellington to Petone railway was again undermined in places. Snow fell on the high country on the 23rd and 24th, and severe hailstorms were remarkably widespread. By the 25th the weather was extremely cold, some stations even recording frost. From the 26th conditions gradually returned to normal.

The month has been remarkable for disturbed conditions in the tropics. In the interior and north of Australia pressures were most unusually low, monsoonal conditions being strongly developed. Between the 18th and the 23rd the low-pressure conditions extended across the Pacific to beyond Samoa. At least two cyclonic centres developed—one near the New Hebrides which ultimately passed close to Suva, where the barometer fell to below 28 in.,

and the other near Samoa. It is probable that there were two separate centres in the latter. Fortunately, the damage done was not severe.

Edward Kidson, Director of Meteorological Services,
Wellington, 7th February, 1929.

MAP SHOWING NEW ZEALAND RAINFALL STATIONS COMPRISED IN *Journal* LIST.

RAINFALL FOR JANUARY, 1929, AT REPRESENTATIVE STATIONS.

No.	Section.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
		North Island.			
		Inches.		Inches.	Inches.
1	Kaitaia	1·52	7	0·40	3·36
2	Russell	0·43	5	0·18	4·11
3	Whangarei	1·63	9	0·45	4·08
4	Auckland	1·38	11	0·69	2·66
5	Hamilton	1·53	11	0·42	3·94
6	Kawhia	2·10	10	0·50	3·52
7	New Plymouth	1·64	11	0·39	4·42
8	Riversdale, Inglewood ..	2·69	12	0·99	7·43
9	Whangamomona	2·47	5	0·79	6·05
10	Eltham	1·60	10	0·55	3·92
11	Tairua	0·82	8	0·24	4·35
12	Tauranga	1·18	10	0·29	4·34
13	Maraehako Station, Opotiki	0·96	6	0·46	4·29
14	Gisborne	2·82	8	1·70	2·97
15	Taupo	0·95	6	0·31	3·71
16	Napier	0·85	8	0·57	3·18
17	Maraekakaho Stn., Hastings	1·62	16	0·86	2·29
18	Taihape	4·38	15	1·09	3·28
19	Masterton	2·48	9	0·80	2·69
20	Patea	1·28	8	0·34	3·79
21	Wanganui	1·78	6	0·67	2·87
22	Foxton	1·65	7	0·96	2·30
23	Wellington (Karori) ..	2·64	15	0·88	3·31
		South Island.			
24	Westport	4·00	18	0·70	6·80
25	Greymouth	6·84	18	1·02	9·03
26	Hokitika	9·06	18	1·78	9·87
27	Ross	13·08	11	3·28	12·04
28	Arthur's Pass	20·05	15	8·96	9·36
29	Okuru, Westland	10·80	14	1·90	12·86
30	Collingwood	4·52	12	1·70	6·95
31	Nelson	1·01	6	0·36	2·82
32	Spring Creek, Blenheim ..	1·77	10	0·55	2·22
33	Tophouse	4·75	13	1·25	5·14
34	Hanmer Springs	3·43	13	0·99	3·74
35	Highfield, Waiau	3·92	10	1·10	2·95
36	Gore Bay	2·65	11	1·11	2·71
37	Christchurch	4·07	11	1·47	2·21
38	Timaru	1·34	13	0·24	2·30
39	Lambrook Station, Fairlie ..	0·92	11	0·20	2·38
40	Benmore Station, Clearburn	3·44	12	1·48	2·77
41	Oamaru	2·30	15	0·44	2·11
42	Queenstown	4·37	13	1·22	2·72
43	Clyde	1·82	9	0·69	1·72
44	Dunedin	4·41	17	0·64	3·36
45	Wendon	4·97	12	1·40	3·22
46	Gore	4·07	16	1·00	3·09
47	Invercargill	5·52	21	1·30	4·01
48	Puysegur Point	8·34	20	1·62	7·22
49	Half-moon Bay, Stewart Is.	5·74	21	1·15	4·68

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SHEEP-DIPPING POINTS.

"INQUIRER," Havelock :—

(1) Please advise me as to what period of time should elapse between the dosing for worms and the dipping of lambs, hoggets, or full-grown sheep. (2) If dipped ewes are put to the ram in mid-March, can you advise me as to the safest period to again dip such pregnant ewes ?

The Live-stock Division :—

(1) At least ten days should elapse between dosing for worms and the following dipping. This applies equally to lambs, hoggets, or full-grown sheep. If the dose contains arsenic and the dipping-fluid is also arsenical a longer period (three weeks) should be allowed. (2) Pregnant ewes can be dipped, if the operation is carried out with care, during the first four to six weeks of pregnancy.

PROPAGATION OF WALNUTS.

O. R. BOSTOCK, Fernhill :—

Will you please tell me the best way to propagate walnuts from a choice tree ? I should say by budding, as I think the trees would bleed too much when cut off for grafting.

The Horticulture Division :—

The propagation of walnut-trees by top-working has been very little practised in other countries until during recent years. A method often adopted is to bud young seedling plants about the month of February. Patch-budding is the method most commonly followed, and the incision is made near the surface of the ground. It is essential to ripen the bud by removing the leaf, leaving the leaf-stem attached to the base of the bud for a period of about ten days before the buds are cut. After placing them in position the buds must be carefully and firmly bound with wax cloth and the development watched. They should be allowed to remain dormant over the winter, and the binding removed before it causes restriction. Where the grafting method is used one-year seedlings are cut back just before they commence growth in the spring. The surface soil is hoed to a depth of 2 in. to 3 in., and the scion is inserted, by means of whip grafting, just below the surface of the ground. Tie the graft in position, and thoroughly wax the union and top of the scion, then hoe the soil back, covering the scion to a depth of 1 in. or 2 in. Long light stakes should be used to train the young growth and prevent it being broken out.

NASAL CATARRH IN DAIRY CATTLE.

"JERSEY," Waitara :—

Kindly inform me whether there is any known cure for nasal catarrh in milking-cows or weaner calves. Is the trouble common ?

The Live-stock Division :—

Nasal catarrh in milking-cows or calves is not a serious affection—in fact, is such that a number of owners pay very little attention to it. Catarrh of the nasal mucous membrane may be caused through irritation of the passages by dust or foreign bodies. In isolated cases of catarrh foreign bodies in the passages, such as small sticks, should always be looked for. Many cases of nasal catarrh in cattle are reported during the warmer months of the year, which invariably disappear at the approach of colder weather without any treatment whatever. This seasonal occurrence of the complaint, without any evidence of foreign bodies

as a causal agent, would suggest that the complaint is analogous to hay-fever in the human subject. It has also been noted that certain families in a herd are more susceptible than others. As regards treatment, the nasal passages require to be carefully syringed out with a solution of boric acid and water, or with normal saline solution. Such weak antiseptic solutions will help in allaying the irritation and assist recovery.

SALT SPRAY FOR KILLING GORSE.

"OVERGROWN," Wellington :—

In the *Journal* for October the Fields Division advises the use of a salt spray for the eradication of gorse. Kindly explain further—(1) Would the spray kill fully grown gorse? (2) Should the gorse be cut previous to the applications? (3) At what season would the spraying be most likely to be effective?

The Fields Division :—

(1) One spraying will not kill the gorse; generally two or more are necessary. Big gorse is, as a rule, easier to kill than small stuff. (2) It is more effective to spray the standing gorse; cutting and spraying at once would not be effective with a salt solution. (3) Spraying is most effective in the summer, when the gorse is in full seed.

WARTY GROWTHS ON COW'S HEAD.

"SUBSCRIBER," Dannevirke :—

My house cow has within the last two months developed growths about the size and shape of small marbles, hard and of a pink colour, bunched together on her chin and lower part of the jaw. They have the appearance of warts, but as they may be malignant growths I should be glad to know what the trouble is, and if one ought to use the milk for the house. The animal is a first calver and in good general condition.

The Live-stock Division :—

The growths described by you are not likely to be of a malignant nature. From their situation, and considering the age of the animal, in all probability they are of the nature of papillomata (warts). We would recommend you to have the animal examined by your local Inspector of Stock, who will inform you regarding the milk-supply. If only warts are present it is quite safe to use. Such growths are best removed by some one with a knowledge of surgery, but as they do not interfere with the cow's condition their removal is at present not desirable.

AN ERRONEOUS STATEMENT.

IN September last a New Zealand monthly pastoral paper published an article, based on news from Argentina, regarding the slaughter in that country of a pedigree bull which was stated to have been affected with foot-and-mouth disease on arrival from Britain. A paragraph to this effect quoted in the article was apparently from the *Review of the River Plate*. That publication, however, has since corrected its original report of the case with a statement that the animal in question was slaughtered owing to tuberculosis, and was not affected with foot-and-mouth disease. In conveying the facts of the case to the New Zealand Government authorities, the English Ministry of Agriculture states that it knows of no case in which foot-and-mouth disease has been carried to another country by means of an animal shipped from Great Britain.

Commercial Orchards.—An aggregate area of nearly 500 acres was planted in commercial orchards during the 1928 planting season in the various fruitgrowing districts.

ESTIMATED YIELDS OF WHEAT, OATS, AND BARLEY.

THE following estimated average yields per acre of wheat, oats, and barley for the season 1928–29 have been compiled by the Census and Statistics Office from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 6th February :—

District.	Wheat. Bushels per Acre.	Oats. Bushels per Acre.	Barley. Bushels per Acre.
North Island	33·94	40·88	35·86
Nelson	25·07	30·00	29·01
Marlborough	27·40	35·91	30·00
Canterbury	33·53	44·53	35·84
Otago	29·99	38·77	35·33
Southland	36·17	45·48	37·74
Average (estimated) for the Dominion, season 1928–29	33·06	43·45	34·49
Average (actual) for the Dominion, season 1927–28	36·56	43·66	40·87

In accordance with the above estimates, the total yield of wheat for the Dominion should be approximately 8,400,000 bushels, as against an actual yield of 9,541,444 bushels for the season 1927–28.

The percentage of oats threshed for the five seasons ending with 1927–28 was 26·76 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 3,500,000 bushels, as against an actual yield of 3,852,687 bushels for the season 1927–28.

The percentage of barley threshed for the five seasons ending with 1927–28 was 98·03 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 750,000 bushels, as against an actual yield of 861,985 bushels for the season 1927–28.

AGRICULTURAL SHOWS, SEASON 1928-29.

THE following show-dates for the remainder of the season have been notified by agricultural and pastoral associations :—

Taranaki Metropolitan Agricultural Society : New Plymouth, 6th and 7th March.
Morrinsville A. and P. Society : Morrinsville, 13th March.
Hawke's Bay A. and P. Society (Autumn Show) : Tomoana, 20th March.
Mayfield A. and P. Association : Mayfield, 23rd March.
Methven A. and P. Association : Methven, 27th March.
Flaxbourne A. and P. Association : Ward, 18th April.

BOOKS RECEIVED.

AGRICULTURAL RESEARCH IN 1927 (Royal Agricultural Society of England). John Murray, London. Price 1s.

CO-OPERATIVE MARKETING OF AGRICULTURAL PRODUCTS. By Michael Murphy, University College, Cork. Longmans, Green, and Co., Ltd., London. Price 3s. 6d.

THE SCIENTIFIC PRINCIPLES OF PLANT PROTECTION. By Hubert Martin, South Eastern Agricultural College, Wye, Kent. Edward Arnold and Co., London. Price 21s.

MASSEY AGRICULTURAL COLLEGE CALENDAR FOR 1929. Palmerston North, N.Z.